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Providing Technical & Business Solutions

DATE: January 22, 2007

TO: Carl Valente, Bill Bradley, Wayne Brooks,
and Jon Himmel, Town of Lexington

FROM: Yi Jiang, Sebesta Blomberg

RE: Energy modeling study for modified DPW facility design
Sebesta Blomberg Project No. 700435

CC: Janet Slemenda and Michael Lawrence, HKT
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MEMORANDUM

Sebesta Blomberg & Associates, Inc. (Sebesta Blomberg) has been retained by the Town of Lexington to provide continuous energy modeling efforts for the modified design documents in January, 2007. The purpose of this memo is to use building energy modeling software, DOE2.1, to:

1. Setup a "Base Case" building based on the modified architectural and MEP design documents.
2. Compare the "Base Case" with several design alternatives for an optimal design.

The table below summarizes the total energy usage and costs for the Base Case and different alternatives. The annual energy cost for the Base Case is about $130,000. Several design alternatives have been studied. For Alternative 1, the geothermal heat pump system saves about $5,000 annually compared to the Base Case: gas fired heating, and DX cooling roof top unit. For Alternative 2, if the vehicle storage spaces are only ventilated to meet code requirements without any heating, the total annual energy cost can be reduced by $10,000. For Alternative 3, if the wall insulation is increased to R-20, the annual energy savings are $4,800. For Alternative 4, if heat recovery is installed for toilets/locker rooms in Admin building, the annual savings are about $1,100. Alternative 5 is to install waste oil heater to provide supplement heating to vehicle garage spaces. The mechanical engineer has estimated the annual heating savings of 2,800 Therms, and therefore $4,200 cost savings.

Category	Annual Energy Cost	Incremental $
Base Case	$129,509	
Alt 1: Replace RTU with Geothermal Heat Pump	$124,361	-$5,148
Alt 2: No Heaing in Vechicle Storage.	$119,385	-$10,125
Alt 3: Increase Wall Insulation	$124,753	-$4,757
Alt 4: Heat Recover in Admin Bld	$128,386	-$1,124
Alt 5: Waste Oil Heater*	$125,309	-$4,200

Input

A summary of the building input information is listed in the table below.

Table: Building input information.

Building Envelop				
Type	**U-value**	**R-value**	**SGHC**	
Roof	0.053	19		
Exterior Wall (Admin)	0.100	10		
Exterior Wall (Warehouse)	0.140	7		
Floor	0.059	17		
Window (Admin)	0.600		0.6	
Window (Warehouse)	0.500		0.6	
Space Internal Loads and Ventilation				
Space Type	**Lighting**	**Plug Power**	**Ventilation**	
	W/Sq Ft.	**W/Sq Ft.**	**No. Persons**	**Outside Air Rate**
Administration Building	1.5	1.5	100	20 CFM/person
Central Storage	1.5	1	2	20 CFM/person
Wash Bay	1	1	1	2 CFM/Sq. Ft. Office operating schedule
Utility space & Operation	1.5	1	2	20 CFM/person
Vehicle Maintenance	1	0.5	5	1.5 CFM/Sq. Ft. Office operating schedule
Vehicle Storage	1	0.5	1	1.5 CFM/Sq. Ft. Assume **2** hour/day Exhaust Fan Operation
Space Operation Temperature (F)				
Space Type	**Summer**		**Winter**	
	6am-7pm wkday	**7pm-6am wkday, weekend**	**6am-7pm wkday**	**7pm-6am wkday, weekend**
Administration Building	75	90	72	55
Central Storage			60	50
Wash Bay			50	50
Utility space & Operation	75	90	72	55
Vehicle Maintenance			60	50
Vehicle Storage			**45**	**45**
HVAC				
Space Type	**System Type**			
Administration Building	Gas heating, DX cooling, VAV Unit with hot water reheat			
Central Storage	Gas-fired Unit Heater. Ventilation air from admin space			
Wash Bay	Gas-fired Heating and Vent			
Utility space & Operation	Gas heating DX cooling RTU			
Vehicle Maintenance	Gas-fired heating and vent with heat recovery			
Vehicle Storage	Gas-fired radiant heaters, CO control exhaust fans			

The utility usage from June 2005 to May 2006 at the existing facility over the last three years was reviewed, and the average flat rates in FY 2007 are used for this study.

Electricity – $0.17/kWh
Natural Gas – $1.5/Therm

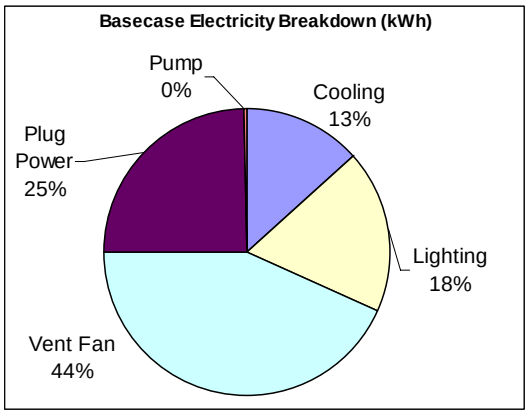
For detailed building area description and energy modeling software, please refer to the previous energy modeling report dated on December 20, 2006. The energy modeling for the modified design has the following major differences from previous work:

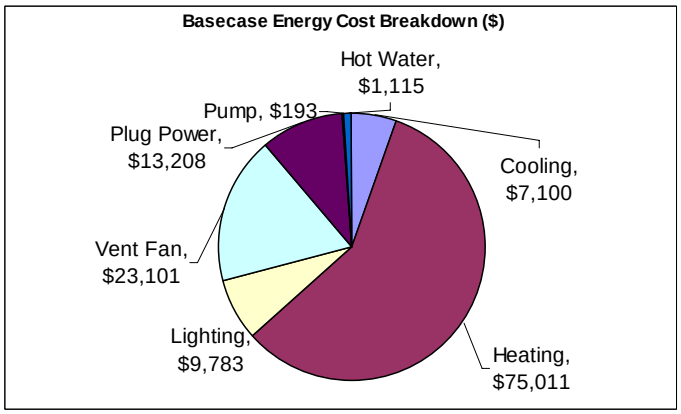
1. Reduction of building area
2. Gas fired heating and DX cooling roof top unit is designed for the admin building
3. Exhaust Fans for vehicle storage spaces operate 2 hours per day for ventilation instead of 3 hours per day in the previous modeling.
4. Vehicle storage space temperature is maintained at 45^{o}F, but not 50^{o}F in the previous design.
5. Some energy efficiency features have been designed:
    - High efficiency HVAC equipment: roof top unit, boiler, heating and ventilation units, etc
    - For VAV RTU, reset discharge air temperature based on warmest zone
    - Daylighting dimming control in the office space of the Admin Building

Results:

Base Case

The figures below show the end use of electricity, and total cost for end uses. It shows that the heating cost constitutes more than half of the total energy cost.





Alternatives

The table below summarizes the total energy usage and costs for the Base Case, and different alternatives. It shows that for the Base Case, the annual electricity consumption is 314,000 kWh, and natural gas consumption for heating is about 51,000 Therms. Also, the annual energy cost is about $130,000.

Table: Calculated energy consumption and costs for Base Case and Alternatives

Category	Strategy Level	Electricity kWh	Natural Gas Therm	Energy Cost $	Incremental $
Base Case		314,023	50,750	$129,509	
Alternatives					
Alt 1: Replace RTU with Geothermal Heat Pump	Existing Utility Rates	342,035	44,143	$124,361	-$5,148
	Utility Rates Tripled in Future	342,035	44,143		-$15,445
Alt 2: No Heaing in Vechicle Storage.	Only Exhaust for ventilaiton	314,023	44,000	$119,385	-$10,125
Alt 3: Increase Wall Insulation	Increase to R-20	310,387	47,991	$124,753	-$4,757
Alt 4: Heat Recover in Admin Bld	Toilets/Locker Rooms	315,593	49,823	$128,386	-$1,124
Alt 5: Waste Oil Heater*	Supplemental heat in vehicle storage	314,023	47,950	$125,309	-$4,200

* Energy savings for Alternative 5 were not energy modeling results, but were estimated by the mechanical designer from RW Sullivan