Appendix L – Overall Cost Analysis

This appendix contains the information used for the life cycle cost analyses for the chillers, cooling towers, and mechanical systems used as a part of the design process.

Please see the all the life cycle cost information on the following pages.

Lifecycle Summary

Project: Hilton Hotel at BWI Airport 4/5/2006
Prepared By: The Pennsylvania State University 5:48:06 PM

Chiller Selection

Life Cycle Cost Analysis

Type of Analysis	Private Sector Lifecycle Analysis	
Type of Design Alternatives	Mutually Exclusive	
Length of Analysis	20	yrs
Minimum Attractive Rate of Return	8.00	%
Income Taxes	Not Considered	

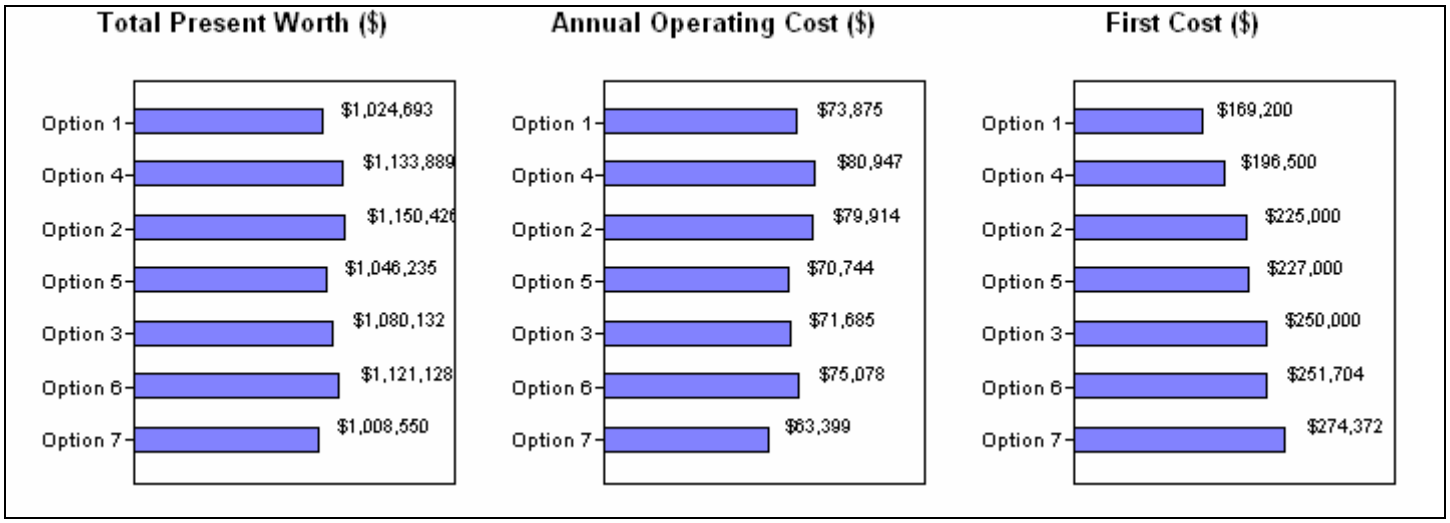


Table 1. Executive Summary

Economic Criteria	Best Design Case for Each Criteria	Value ($)
Incremental NPW Savings Analysis	Option 7 - (2) Trane CTV-AFD (12F)	-
Lowest Total Present Worth	Option 7 - (2) Trane CTV-AFD (12F)	$1,008,550
Lowest Annual Operating Cost	Option 7 - (2) Trane CTV-AFD (12F)	$63,399
Lowest First Cost	Option 1 - (2) Carrier 19XRVs	$169,200

Table 2. Design Cases Ranked by First Cost

Design Case Name	Design Case Short Name	Total Present Worth ($)	Annual Operating Cost ($/yr)	First Cost ($)
Option 1 - (2) Carrier 19XRVs	Option 1	$1,024,693	$73,875	$169,200
Option 4 - (1) McQuay WDC w/ IGV	Option 4	$1,133,889	$80,947	$196,500
Option 2 - (2) York MaxEs	Option 2	$1,150,426	$79,914	$225,000
Option 5 - (1) McQuay WDC w/ VFD	Option 5	$1,046,235	$70,744	$227,000
Option 3 - (2) McQuay WSCs	Option 3	$1,080,132	$71,685	$250,000
Option 6 - (1) Trane CTV, (1) CTV-AFD (12F)	Option 6	$1,121,128	$75,078	$251,704
Option 7 - (2) Trane CTV-AFD (12F)	Option 7	$1,008,550	$63,399	$274,372

Table 3. Incremental Analysis Data

Challenger	Base Case	Additional First Cost ($)	NPW Savings ($)	IRR (%)	Payback Period (yrs)
Option 4	Option 1 [Winner]	$27,300	$-109,196	n/a	n/a
Option 2	Option 1 [Winner]	$55,800	$-125,733	n/a	n/a
Option 5	Option 1 [Winner]	$57,800	$-21,542	2.79	n/a
Option 3	Option 1 [Winner]	$80,800	$-55,439	n/a	n/a
Option 6	Option 1 [Winner]	$82,504	$-96,435	n/a	n/a
Option 7 [Winner]	Option 1	$105,172	$16,143	9.86	15.6

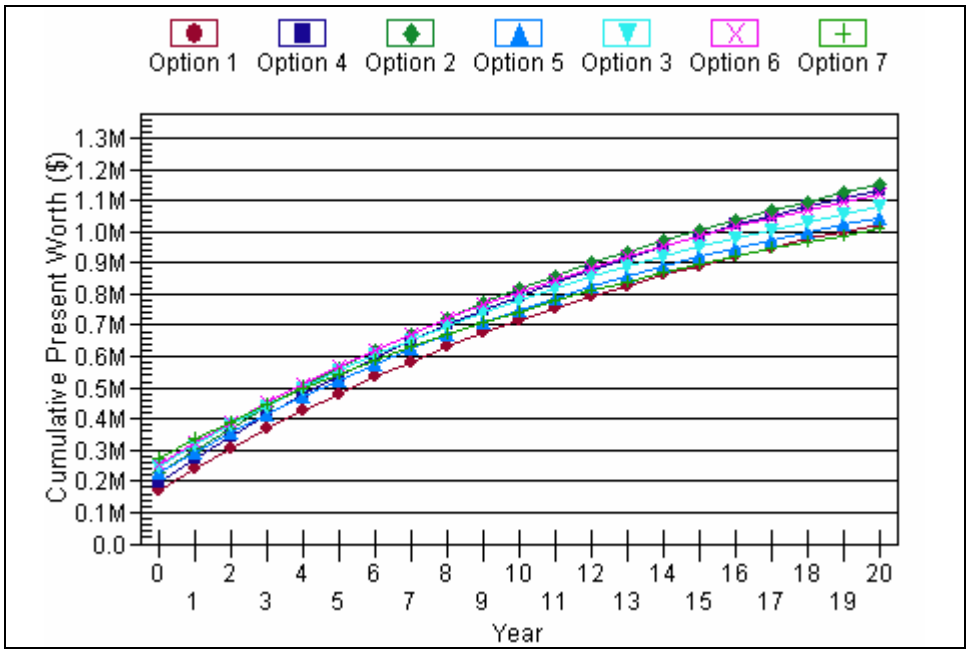
Total Present Worth Profiles

Project: Hilton Hotel at BWI Airport 4/5/2006
Prepared By: The Pennsylvania State University 5:48:08 PM

Chiller Selection

Life Cycle Cost Analysis

Type of Analysis	Private Sector Lifecycle Analysis	
Type of Design Alternatives	Mutually Exclusive	
Length of Analysis	20	yrs
Minimum Attractive Rate of Return	8.00	%
Income Taxes	Not Considered	



Design Cases Ranked by First Cost

Design Case Name	Design Case Short Name	Total Present Worth ($)	Annual Operating Cost ($/yr)	First Cost ($)
Option 1 - (2) Carrier 19XRVs	Option 1	$1,024,693	$73,875	$169,200
Option 4 - (1) McQuay WDC w/ IGV	Option 4	$1,133,889	$80,947	$196,500
Option 2 - (2) York MaxEs	Option 2	$1,150,426	$79,914	$225,000
Option 5 - (1) McQuay WDC w/ VFD	Option 5	$1,046,235	$70,744	$227,000
Option 3 - (2) McQuay WSCs	Option 3	$1,080,132	$71,685	$250,000
Option 6 - (1) Trane CTV, (1) CTV-AFD (12F)	Option 6	$1,121,128	$75,078	$251,704
Option 7 - (2) Trane CTV-AFD (12F)	Option 7	$1,008,550	$63,399	$274,372

Lifecycle Summary

Project: Hilton Hotel at BWI Airport
Prepared By: The Pennsylvania State University

4/4/2006
6:02:52 PM

Cooling Tower Selection

Life Cycle Cost Analysis

Type of Analysis ..... Private Sector Lifecycle Analysis
Type of Design Alternatives ..... Mutually Exclusive
Length of Analysis ..... 20 yrs
Minimum Attractive Rate of Return ..... 8.00 %
Income Taxes ..... Not Considered

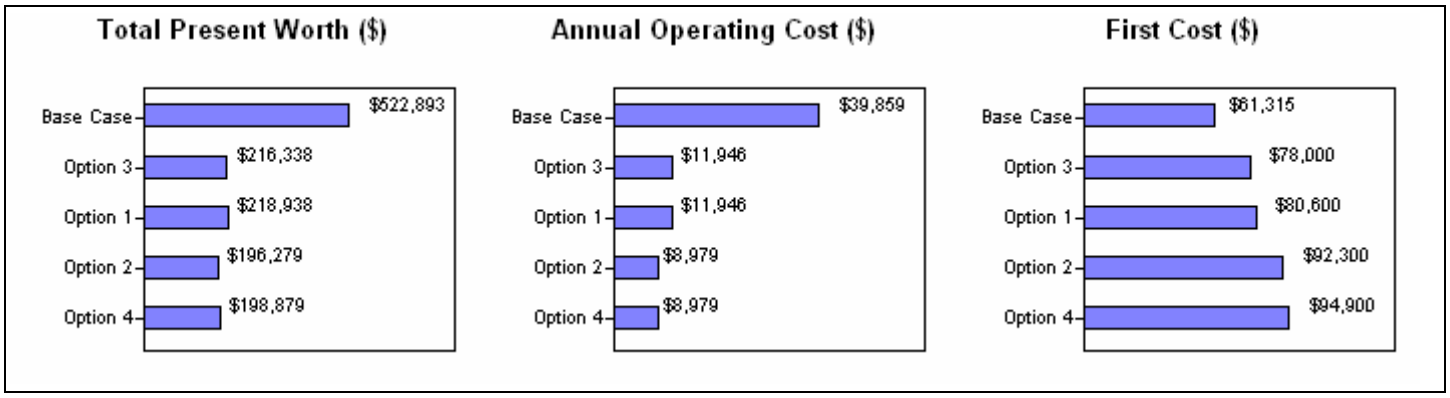


Table 1. Executive Summary

Economic Criteria	Best Design Case for Each Criteria	Value ($)
Incremental NPW Savings Analysis	Option 2 - Marley NC8306EL2	-
Lowest Total Present Worth	Option 2 - Marley NC8306EL2	$196,279
Lowest Annual Operating Cost	Option 2 - Marley NC8306EL2	$8,979
Lowest First Cost	Base Case - Original Design	$61,315

Table 2. Design Cases Ranked by First Cost

Design Case Name	Design Case Short Name	Total Present Worth ($)	Annual Operating Cost ($/yr)	First Cost ($)
Base Case - Original Design	Base Case	$522,893	$39,859	$61,315
Option 3 - Marley NC8305F2	Option 3	$216,338	$11,946	$78,000
Option 1 - Marley NC8305FL2	Option 1	$218,938	$11,946	$80,600
Option 2 - Marley NC8306EL2	Option 2	$196,279	$8,979	$92,300
Option 4 - Marley NC8307E2	Option 4	$198,879	$8,979	$94,900

Table 3. Incremental Analysis Data

Challenger	Base Case	Additional First Cost ($)	NPW Savings ($)	IRR (%)	Payback Period (yrs)
Option 3 [Winner]	Base Case	$16,685	$306,555	172.63	0.6
Option 1	Option 3 [Winner]	$2,600	$-2,600	n/a	n/a
Option 2 [Winner]	Option 3	$14,300	$20,059	22.63	5.8
Option 4	Option 2 [Winner]	$2,600	$-2,600	n/a	n/a

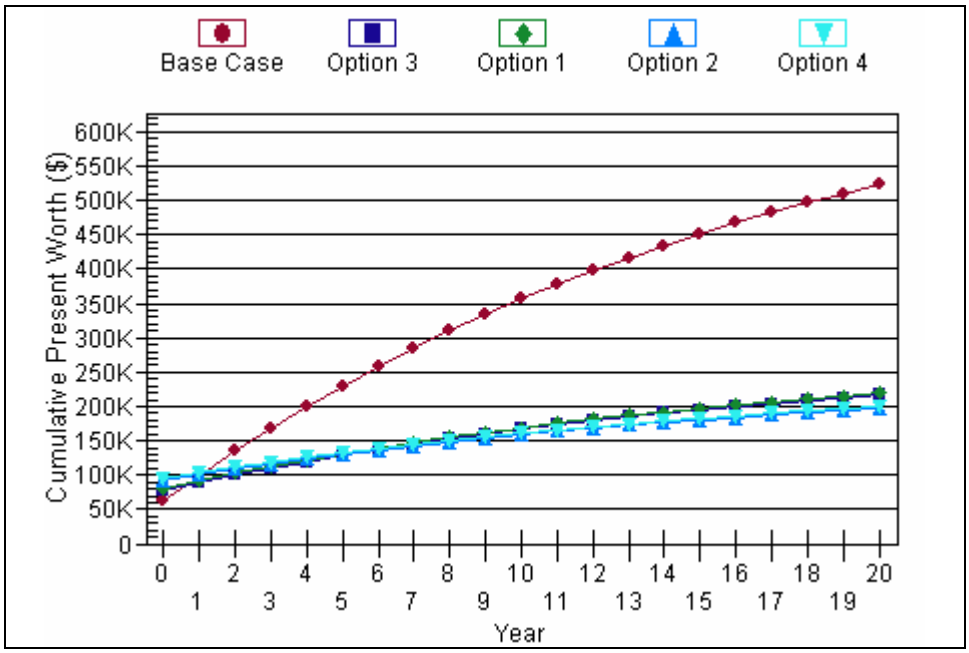
Total Present Worth Profiles

Project: Hilton Hotel at BWI Airport 4/4/2006
Prepared By: The Pennsylvania State University 6:02:53 PM

Cooling Tower Selection

Life Cycle Cost Analysis

Type of Analysis	Private Sector Lifecycle Analysis	
Type of Design Alternatives	Mutually Exclusive	
Length of Analysis	20	yrs
Minimum Attractive Rate of Return	8.00	%
Income Taxes	Not Considered	



Design Cases Ranked by First Cost

Design Case Name	Design Case Short Name	Total Present Worth ($)	Annual Operating Cost ($/yr)	First Cost ($)
Base Case - Original Design	Base Case	$522,893	$39,859	$61,315
Option 3 - Marley NC8305F2	Option 3	$216,338	$11,946	$78,000
Option 1 - Marley NC8305FL2	Option 1	$218,938	$11,946	$80,600
Option 2 - Marley NC8306EL2	Option 2	$196,279	$8,979	$92,300
Option 4 - Marley NC8307E2	Option 4	$198,879	$8,979	$94,900

Lifecycle Summary

Project: Hilton Hotel at BWI Airport 4/5/2006
Prepared By: The Pennsylvania State University 8:30:27 PM

Mechanical Systems

Life Cycle Cost Analysis

Type of Analysis ..... Private Sector Lifecycle Analysis
Type of Design Alternatives ..... Mutually Exclusive
Length of Analysis ..... 20 yrs
Minimum Attractive Rate of Return ..... 8.00 %
Income Taxes ..... Not Considered

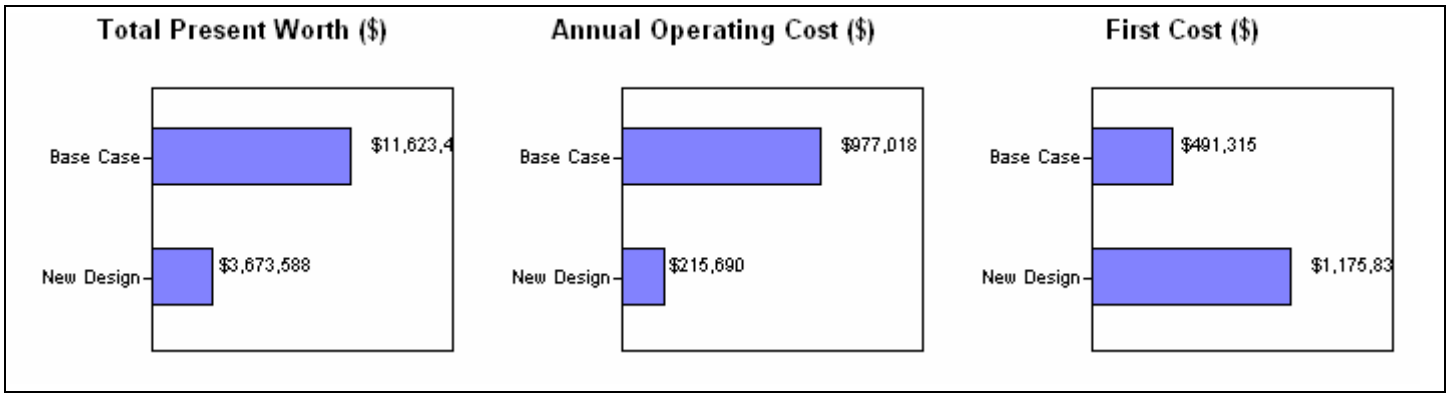


Table 1. Executive Summary

Economic Criteria	Best Design Case for Each Criteria	Value ($)
Incremental NPW Savings Analysis	Chilled Water Plant Design	-
Lowest Total Present Worth	Chilled Water Plant Design	$3,673,588
Lowest Annual Operating Cost	Chilled Water Plant Design	$215,690
Lowest First Cost	Base Case - Original Design	$491,315

Table 2. Design Cases Ranked by First Cost

Design Case Name	Design Case Short Name	Total Present Worth ($)	Annual Operating Cost ($/yr)	First Cost ($)
Base Case - Original Design	Base Case	$11,623,441	$977,018	$491,315
Chilled Water Plant Design	New Design	$3,673,588	$215,690	$1,175,838

Table 3. Incremental Analysis Data

Challenger	Base Case	Additional First Cost ($)	NPW Savings ($)	IRR (%)	Payback Period (yrs)
New Design [Winner]	Base Case	$684,523	$7,949,854	114.23	1.0

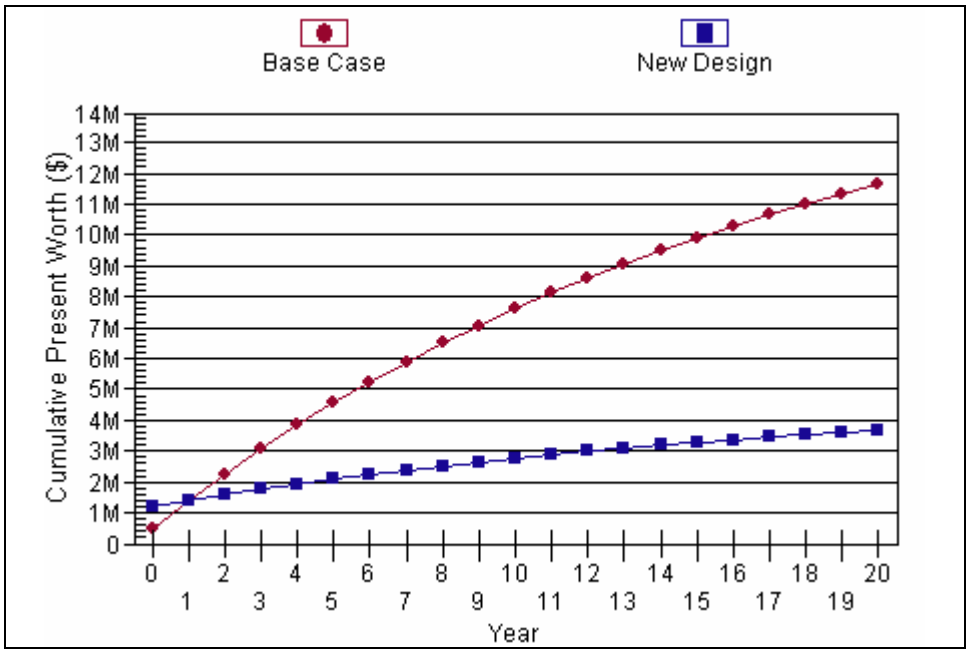
Total Present Worth Profiles

Project: Hilton Hotel at BWI Airport 4/5/2006
Prepared By: The Pennsylvania State University 8:30:28 PM

Mechanical Systems

Life Cycle Cost Analysis

Type of Analysis	Private Sector Lifecycle Analysis	
Type of Design Alternatives	Mutually Exclusive	
Length of Analysis	20	yrs
Minimum Attractive Rate of Return	8.00	%
Income Taxes	Not Considered	



Design Cases Ranked by First Cost

Design Case Name	Design Case Short Name	Total Present Worth ($)	Annual Operating Cost ($/yr)	First Cost ($)
Base Case - Original Design	Base Case	$11,623,441	$977,018	$491,315
Chilled Water Plant Design	New Design	$3,673,588	$215,690	$1,175,838

Analysis Details

Project: Hilton Hotel at BWI Airport 4/5/2006
Prepared By: The Pennsylvania State University 8:30:28 PM

Mechanical Systems

Life Cycle Cost Analysis

Type of Analysis ..... Private Sector Lifecycle Analysis
Type of Design Alternatives ..... Mutually Exclusive
Length of Analysis ..... 20 yrs
Minimum Attractive Rate of Return ..... 8.00 %
Income Taxes ..... Not Considered

1A. Summary of Results

Base Case	Base Case - Original Design [Base Case]
Challenger **[Winner]**	Chilled Water Plant Design [New Design]
[Base Case] Total Present Worth ($)	$11,623,441
[New Design] Total Present Worth ($)	$3,673,588
Net Present Worth Savings ($)	$7,949,854
Internal Rate of Return	114.2 %
Payback Period (yrs)	1.0 years

1B. Comparative Analysis Details

		Cash Flow (Present Worth $)			SIR and Payback Calculation (Present Worth $)				
Year	**Date**	**[Base Case] Cash Flow ($)**	**[New Design] Cash Flow ($)**	**Net Present Worth Savings ($)**	**Operating Cost Savings ($)**	**Cumulative Operating Cost Savings ($)**	**Additional Investment Cost ($)**	**Cumulative Additional Investment Cost ($)**	**Year-End SIR**
0	Initial	491,315	1,175,838	-684,523	0	0	684,523	684,523	0.000
1	1	922,739	203,707	719,032	719,032	719,032	0	684,523	1.050
2	2	856,212	192,390	663,821	663,821	1,382,853	0	684,523	2.020
3	3	808,644	181,702	626,942	626,942	2,009,796	0	684,523	2.936
4	4	763,720	171,607	592,112	592,112	2,601,908	0	684,523	3.801
5	5	721,291	162,074	559,217	559,217	3,161,125	0	684,523	4.618
6	6	681,219	153,069	528,150	528,150	3,689,275	0	684,523	5.390
7	7	643,373	144,566	498,808	498,808	4,188,083	0	684,523	6.118
8	8	607,631	136,534	471,096	471,096	4,659,179	0	684,523	6.806
9	9	573,873	128,949	444,924	444,924	5,104,103	0	684,523	7.456
10	10	541,991	121,785	420,206	420,206	5,524,310	0	684,523	8.070
11	11	511,881	115,019	396,862	396,862	5,921,171	0	684,523	8.650
12	12	483,443	108,629	374,814	374,814	6,295,985	0	684,523	9.198
13	13	456,585	102,594	353,991	353,991	6,649,976	0	684,523	9.715
14	14	431,219	96,895	334,325	334,325	6,984,300	0	684,523	10.203
15	15	407,263	91,512	315,751	315,751	7,300,051	0	684,523	10.664
16	16	384,637	86,428	298,209	298,209	7,598,260	0	684,523	11.100
17	17	363,268	81,626	281,642	281,642	7,879,902	0	684,523	11.512
18	18	343,087	77,091	265,995	265,995	8,145,898	0	684,523	11.900
19	19	324,026	72,808	251,218	251,218	8,397,115	0	684,523	12.267
20	20	306,025	68,764	237,261	237,261	8,634,377	0	684,523	12.614
Totals		11,623,441	3,673,588	7,949,854	8,634,377		684,523		

Mechanical Equipment First Costs

Table L1 - Mechanical Equipment Options First Costs

Equipment	Option	Manufacturer	Model	Quantity	Price Each	Total Price	Option Total
Chillers							
	1	Carrier	19XRV	2	$84,600	$169,200	$169,200
	2	York	MaxE	2	$112,500	$225,000	$225,000
	3	McQuay	WSC	2	$125,000	$250,000	$250,000
	4	McQuay	WDC-IGV	1	$196,500	$196,500	$196,500
	5	McQuay	WDC-VFD	1	$227,000	$227,000	$227,000
	6	Trane	CTV	1	$114,518	$251,704	$251,704
	6	Trane	CTV-AFD	1	$137,186	-	-
	7	Trane	CTV-AFD	2	$137,186	$274,372	$274,372
Cooling Towers							
	1	Marley	NC8305FL2	2	$40,300	$80,600	$80,600
	2	Marley	NC8306EL2	2	$46,150	$92,300	$92,300
	3	Marley	NC8305F2	2	$39,000	$78,000	$78,000
	4	Marley	NC8307E2	2	$47,450	$94,900	$94,900
Air Handling Units							
	1	Carrier	39MN-50	1	$30,100	$30,100	$90,900
	1	Carrier	39MN-40	1	$29,500	$29,500	-
	1	Carrier	39MN-21	1	$17,600	$17,600	-
	1	Carrier	39MN-12	1	$13,700	$13,700	-
Rooftop Units							
	1	Carrier	39MW-06	1	$17,600	$17,600	$101,800
	1	Carrier	39MW-30	1	$30,400	$30,400	-
	1	Carrier	39MW-12	1	$20,400	$20,400	-
	1	Carrier	39MW-06	1	$17,400	$17,400	-
	1	Carrier	39MW-03	1	$16,000	$16,000	-
Dedicated Outside Air Units							
	1	Semco	PVS-13	1	$90,193	$90,193	$193,186
	1	Semco	PVS-18	1	$102,993	$102,993	-
Fan Coil Units							
	1	Carrier	42S-300	128	$1,335	$170,880	$386,880
	1	Carrier	42S-400	160	$1,350	$216,000	-
	2	Enviro-Tec	VHC-04	128	$1,850	$236,800	$532,800
	2	Enviro-Tec	VHC-04	160	$1,850	$296,000	-
Pumps							
	1	Bell&Gossett	1510-5G	2	$8,389	$16,778	$30,750
	1	Bell&Gossett	1510-5BC	2	$6,986	$13,972	-
Heat Exchanger							
	1	Bell&Gossett	P41	1	28150	$28,150	$28,150

Table L2 - Mechanical Equipment Selected First Costs

Equipment Costs	Option No	Manufacturer	Model No	Qty	Price Each	Total Price	Option Total	Annual Energy Costs
Chillers								
First Cost	1	Carrier	19XRV	2	$84,600	$169,200	$169,200	$73,875
Operating Cost	7	Trane	CTV-AFD	2	$137,186	$274,372	$274,372	$63,399
Selected	7	Trane	CTV-AFD	2	$137,186	$274,372	$274,372	$63,399
Cooling Towers								
First Cost	3	Marley	NC8305F2	2	$39,000	$78,000	$78,000	$11,946
Operating Cost	2	Marley	NC8306EL2	2	$46,150	$92,300	$92,300	$8,979
Selected	2	Marley	NC8306EL2	2	$46,150	$92,300	$92,300	$8,979
Fan Coil Units								
First Cost	1	Carrier	42S	288	$2,685	$386,880	$386,880	$5 < Option 2
Operating Cost	1	Carrier	42S	288	$2,685	$386,880	$386,880	$5 < Option 2
Selected	1	Carrier	42S	288	$2,685	$386,880	$386,880	$5 < Option 2
Air Handling Units								
Selected (incl all)	1	Carrier	39MN	1	$90,900	$90,900	$90,900	N/A
Rooftop Units								
Selected (incl all)	1	Carrier	39MW	1	$79,300	$79,300	$79,300	N/A
Dedicated Outdoor Air Units								
Selected (incl all)	1	Semco	PVS	1	$193,186	$193,186	$193,186	N/A
Pumps								
Selected (incl all)	1	Bell & Gossett	1510	2	$15,375	$30,750	$30,750	N/A
Heat Exchanger								
Selected	1	Bell & Gossett	P41	1	$28,150	$28,150	$28,150	N/A

Mechanical System Total Equipment First Cost: $1,175,838