SIBLEY MEMORIAL HOSPITAL

GRAND OAKS ASSISTED LIVING FACILITY

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Architectural Engineering
Lighting/Electrical Option
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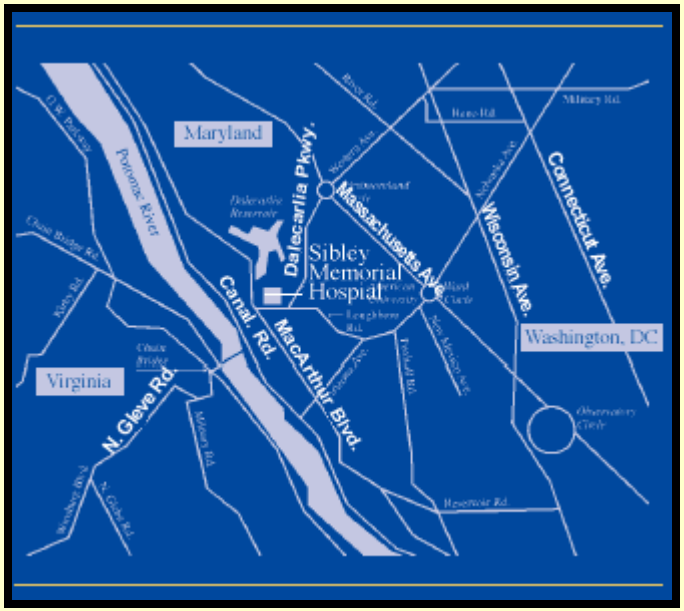
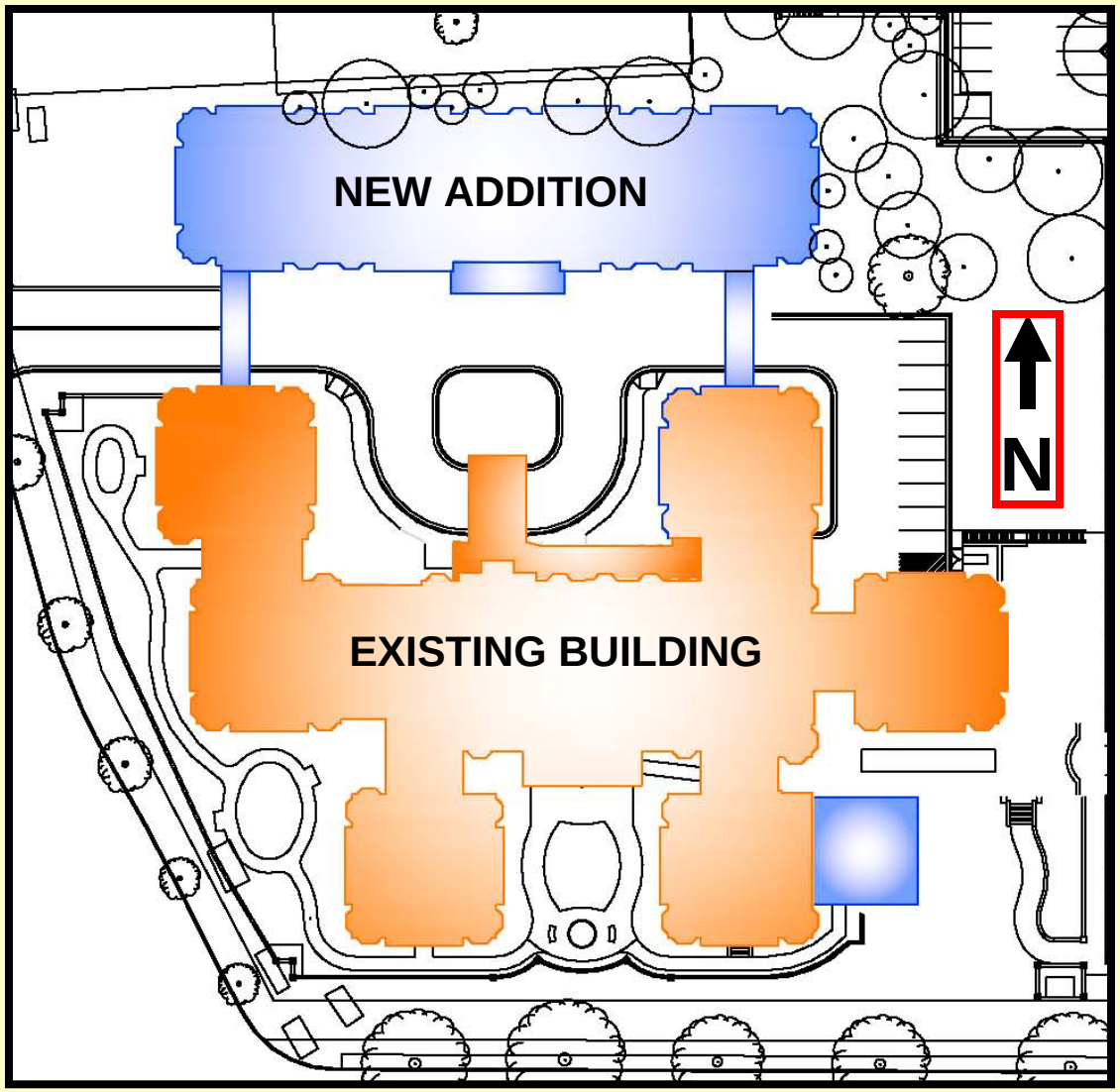
Building Overview

- **Location: Loughboro Road, Washington, D.C.**
- **Size: 123,000 square feet + 67,000 sq. ft. addition**
- **Owner: Sibley Memorial Hospital**
- **Occupancy type: Older Adults – 80+ years of age**



Presentation Outline

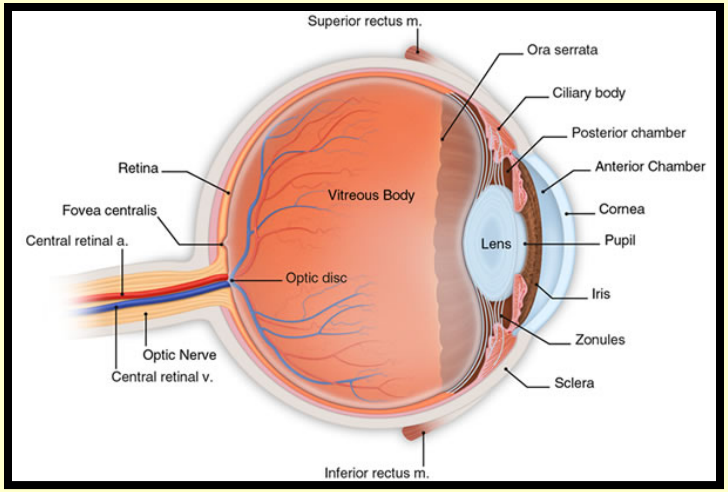
- **Existing Building**
  - -Lighting Depth
    - Living Room/Library
    - Dining Room Addition
    - Lobby
    - Exterior Walkway/Entry
- **New Addition**
  - Mechanical Breadth
    - Feasibility Study of Geothermal Heat Pumps
  - Electrical Depth
    - New Distribution System
    - Cost Comparison
  - Construction Management Breadth
    - Cost Analysis of Geothermal Heat Pumps

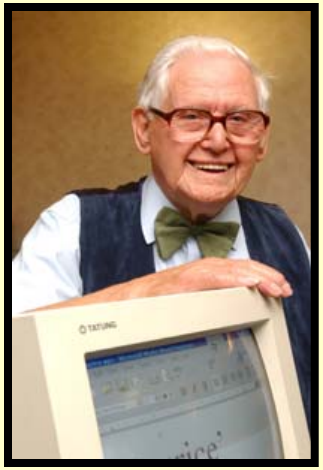


Lighting Depth

Visibility Issue with Older Adults

- pupils become smaller – 33% less light reaches retina after age 65
- require higher illuminance levels
- floaters – scattering of light within eye
- increased sensitivity to glare
- decreased contrast sensitivity
- decrease in adaptation time
- altered color perception



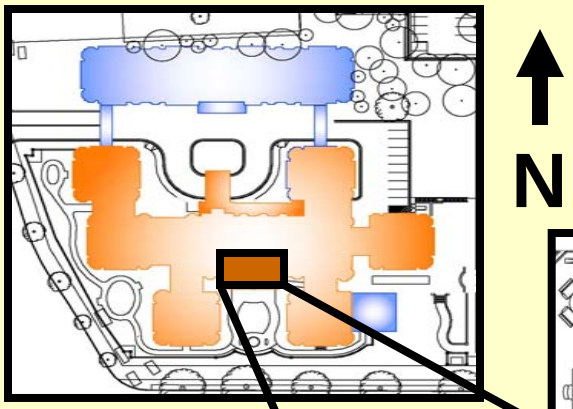


Design Goals for all spaces

- provide comfortable home like atmosphere
- avoid glare – direct and reflected
- uniformity in general lighting
- balance of daylight and interior ambient light
- avoid strong contrast ratios

Living Room/Library

Lighting Depth – Living Room/Library



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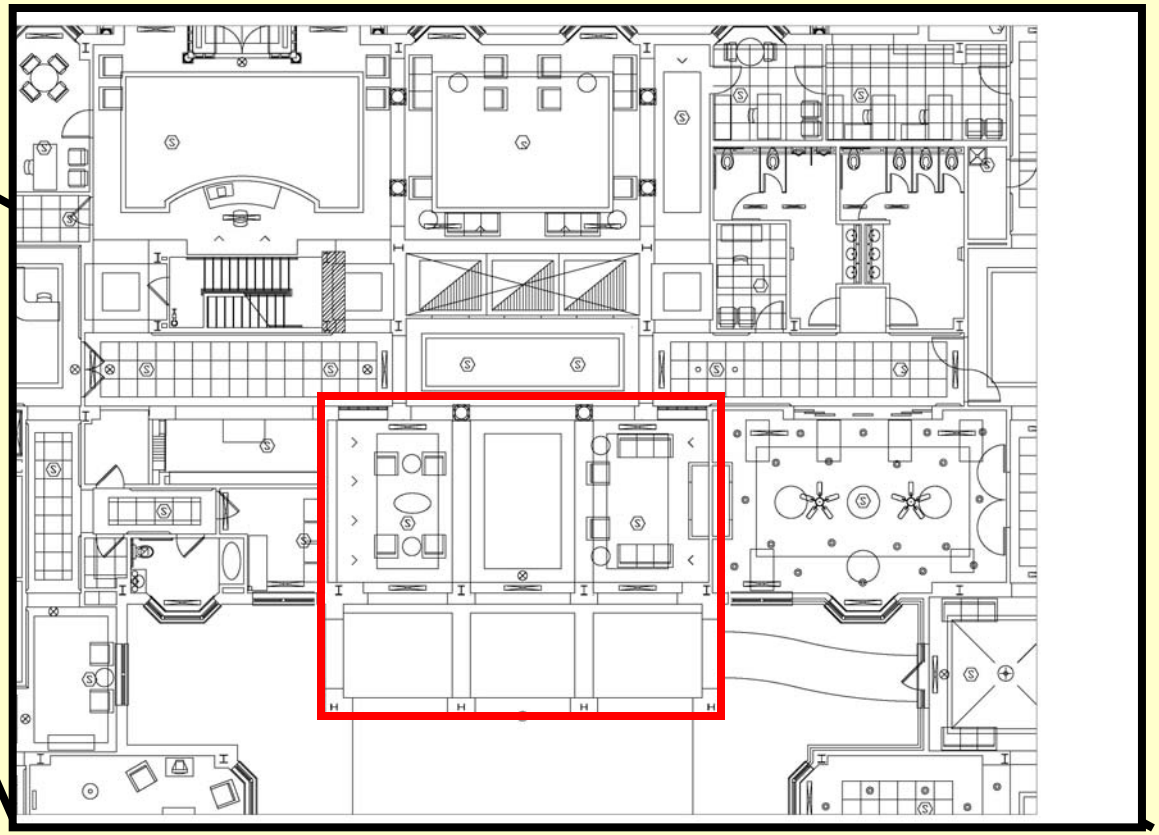
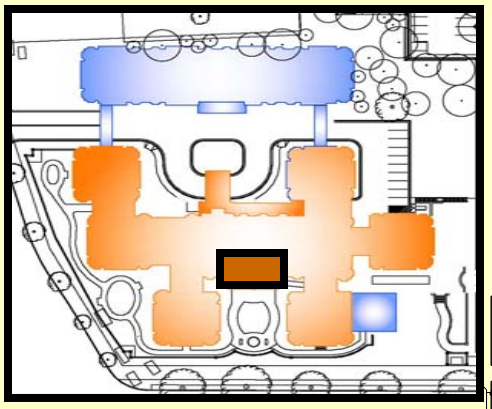
- Living Room Area
- Covered Porch



Lighting Depth - Living Room/Library – Space Details



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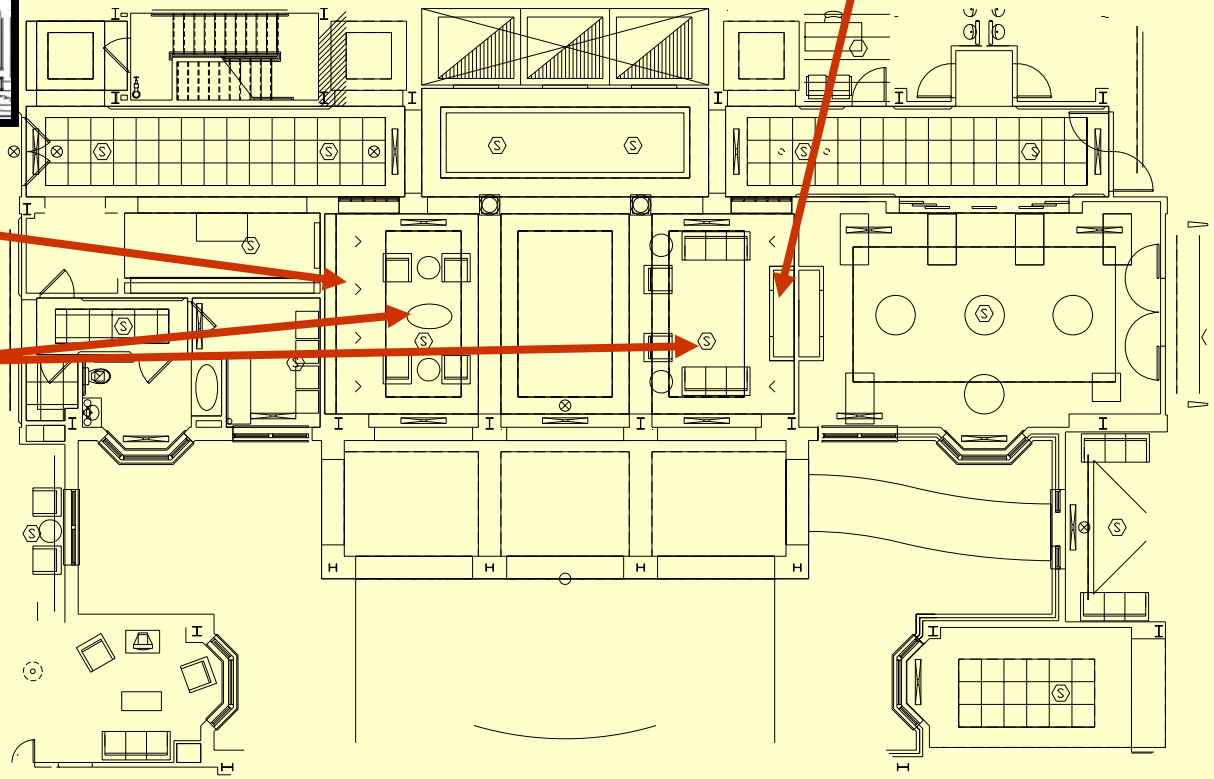
Fire Place

Bookshelves

Reading/Relaxing



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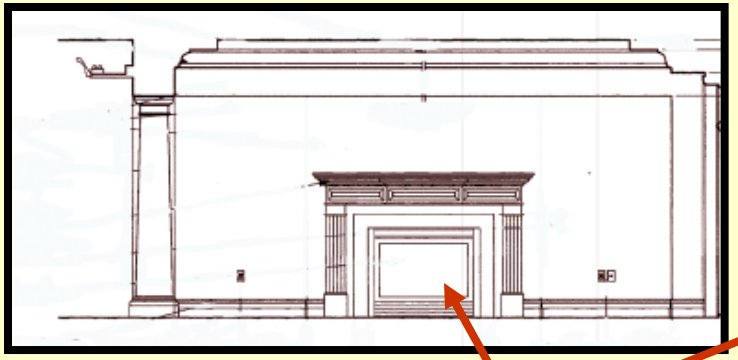
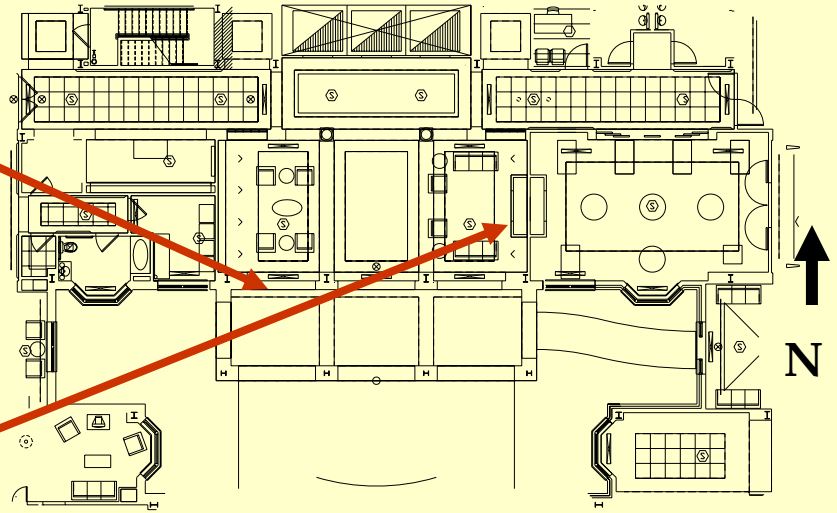
Lighting Depth - Living Room/Library – Space Details

South Elevation

Large Expanse of South Facing Glass – Overhang reduces direct glare



East Elevation



Fire Place

Lighting Depth - Living Room/Library – Schematic Design

- **Ceiling – cove lighting for diffuse ambient light**
- **Columns – highlighted to give dimension/contrast to space**
- **Floor – shadows kept to minimum with indirect lighting**
- **Furniture – showered with diffuse indirect lighting from cove**
- **Seating Areas – table lamps to make each space more intimate**
- **Fire Place – mantle highlighted to create a focal point in the space**

Power Allowance

ASHRAE/IESNA 90.1 – **1.3 watts/ft2**
1.0 watts/ft2 – for decorative chandelier-type luminaries or sconces or for highlighting art or exhibit

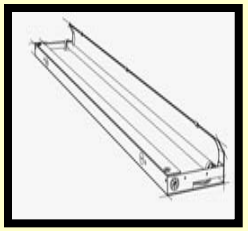
Target Illuminance Values

Horizontal – **40-50 fc**

Vertical – **20 fc** (bookshelves

Lighting Depth - Living Room/Library –Layout

A3
(1)32WT8

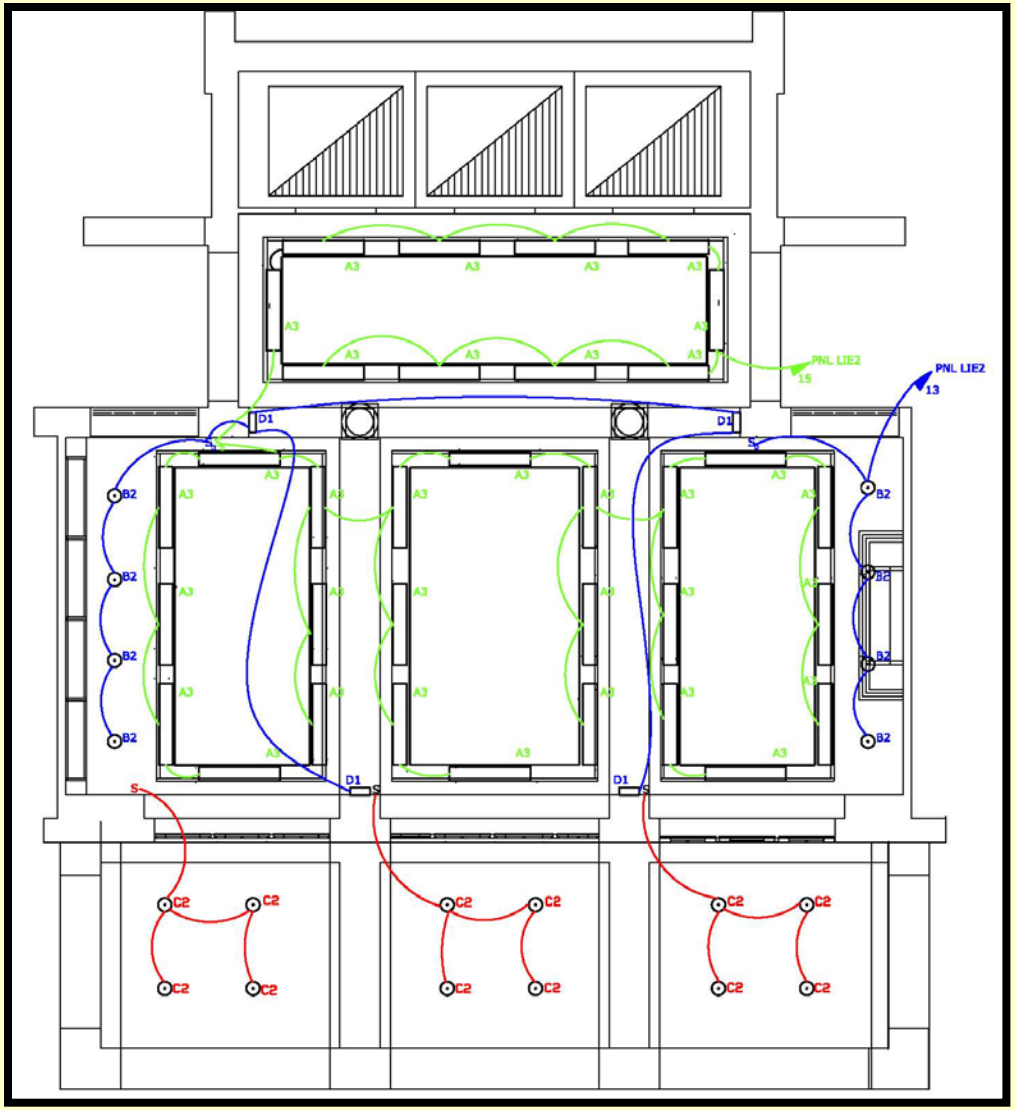


B2
(2)26W-CF

C2
(1)18W-CF

D1
(1)18W-CF

D2
(1)30W-CF



Lighting Depth - Living Room/Library – Final Design Rendering

Lighting Depth - Living Room/Library – Final Design Rendering

Living Room/Library – Conclusions

Power Allowance - OK

ASHRAE/IESNA 90.1 – **1.3 watts/ft2**
1.0 watts/ft2 – for decorative chandelier-type luminaries or sconces or for highlighting art or exhibit

Target Illuminance Values

Horizontal – **40-50 fc**

Vertical – **20 fc** (bookshelves

Design Illuminance Values - OK

Horizontal – **43 avg**

Vertical – **20 fc** avg

LIVING ROOM/LIBRARY

Main Room

Luminaire	#	ballast watts	total watts	
B2	8	58.17	465.36	
A3	24	36	864	
D1	4	33.24	132.96	
D2	8	30	240	
			1702.32	watt total
			820	sq footage
			2.076	**w/sqft**

Elevator Lobby

Luminaire	#	ballast watts	total watts	
A3	10	36	360	
			360	watt total
			250	sq footage
			1.44	**w/sqft**

Porch

Luminaire	#	ballast watts	total watts	
C2	12	22.16	265.92	
			265.92	watt total
			516	sq footage
			0.51534884	**w/sqft**

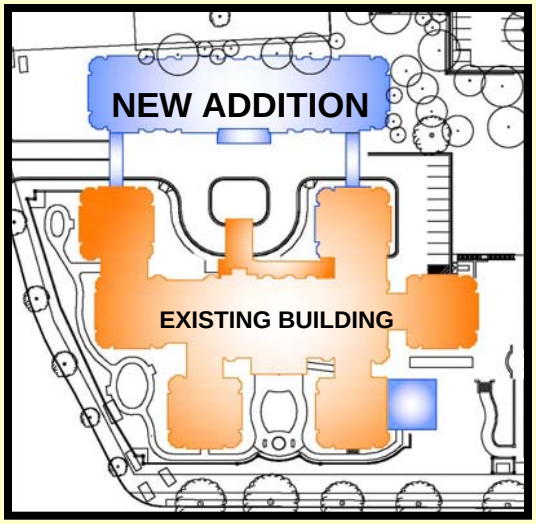
- **provide comfortable home like atmosphere √ OK**
- **avoid glare – direct and reflected √ OK**
- **uniformity in general lighting √ OK**
- **balance of daylight and interior ambient light √ OK**
- **avoid strong contrast ratios √ OK**

Branch Circuit Check - OK

SPACE	PANEL	V	CKT #	CONNECTED VA	CON'T LOAD(1.25)	Max amps/ckt
Living Room	L1E2	277	13	864.24	1080.3	<4436
Living Room	L1E2	277	15	1224	1530	<4437

Mechanical Feasibility Study

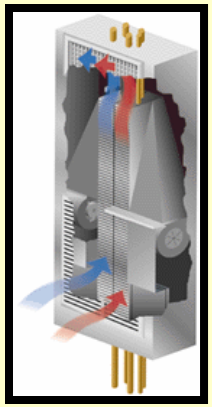
– A look at Geothermal Heat Pumps

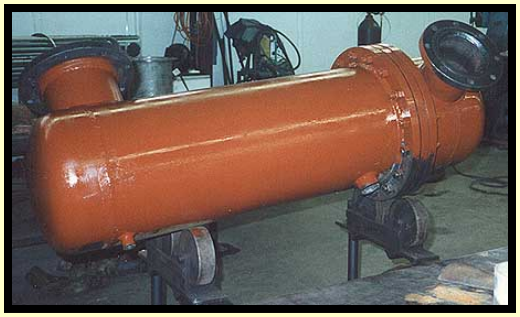


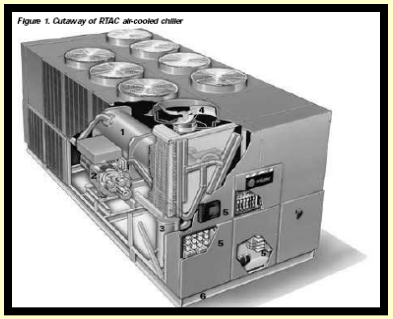
Mechanical Feasibility Study

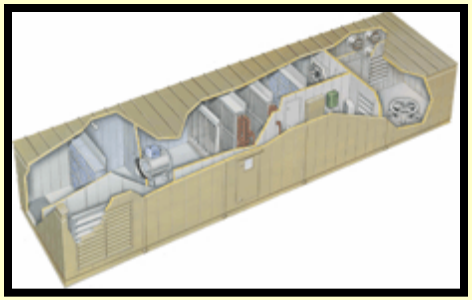
Current System

- 4 – Pipe Fan Coil Units – 100% re-circulated air
  - 2 – pipes provide heating hot water supply and return water
  - 2 – pipes provide chilled water supply and return
- 2 – Instantaneous Steam Fired Hot Water Heaters
- 1 – Air Cooled, Roof Mounted Chiller
- 1 – Energy Recover Air Handling Unit to Supply Outdoor Air Requirement





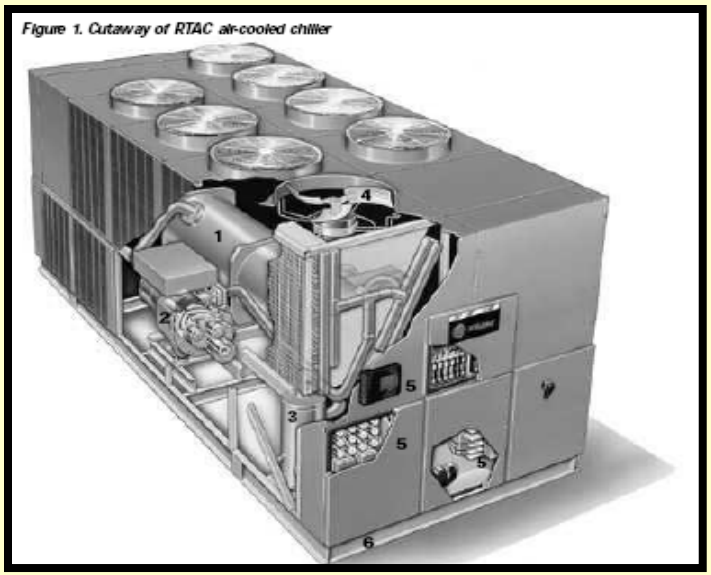




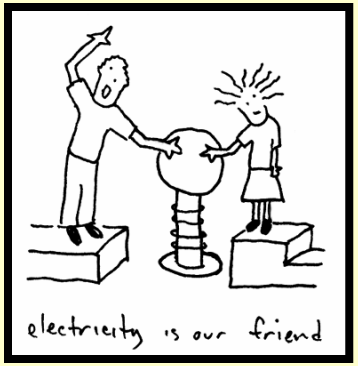
Mechanical Feasibility Study

Concern with Current System

- 1 – Air Cooled Roof Mounted Chiller
  - 182 KW – Max Power Input
  - Draws 6X current during start-up
  - Energy Efficiency Ratio(E.E.R) ~ 10
  - This affected the Electrical Distribution System
  - Electricity Rates Baltimore/Washington Area



Mechanical Feasibility Study



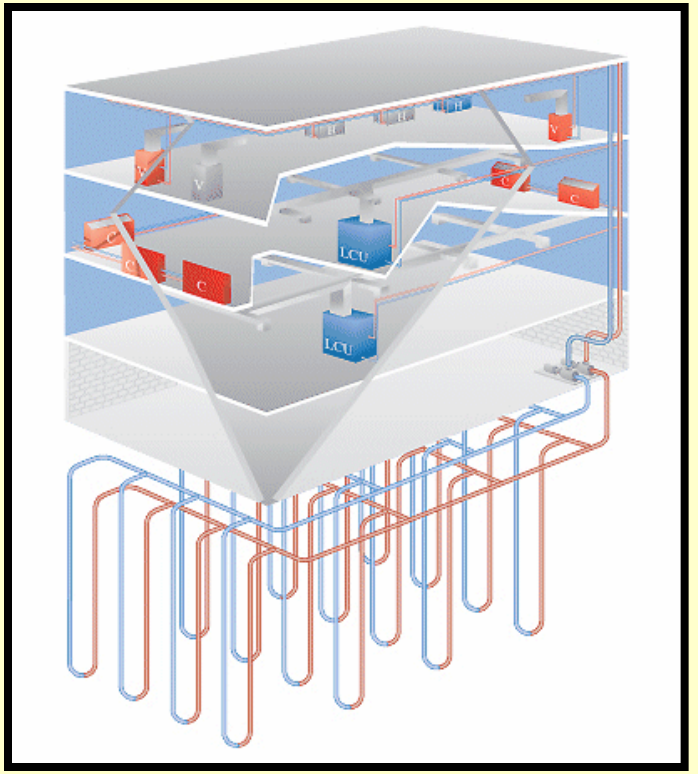
Electricity Rates

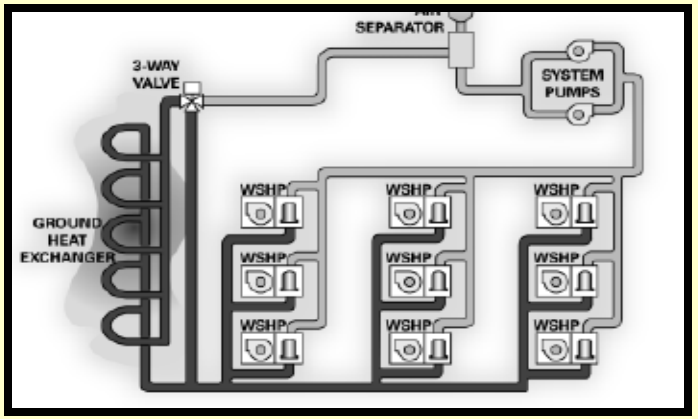
- 37 – 72 Percent Increase Summer of 2006
  - 2 Part Problem
    - 1993 Lawmakers capped the electric rates and set them 6.5% below current rates
    - 1999 utility deregulating, thereby assessing supply and distribution charges
- These two issues, along with inflation and the ever growing demand for electricity result in Electricity Rate Increases

Mechanical Feasibility Study

Geothermal Heat Pumps

- Eliminate 4-pipe fan coil units and associated equipment supplying their heating hot water and chilled water needs
- Replace with closed-loop, earth-coupled, Water-to-Air Heat Pumps
  - Horizontal Loop
    - 2 pipe system
    - Variable Rate Pump moving
      - 40 – 70 degree loop temperature
    - 3 – way diverting valve
  - Side Stream Straight Pump
    - Antifreeze Solution to either absorb heat or extract heat from the constant ground temperature

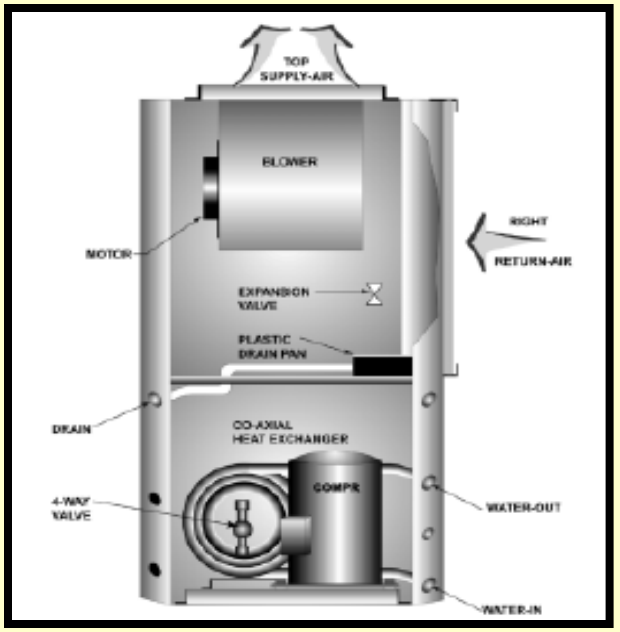


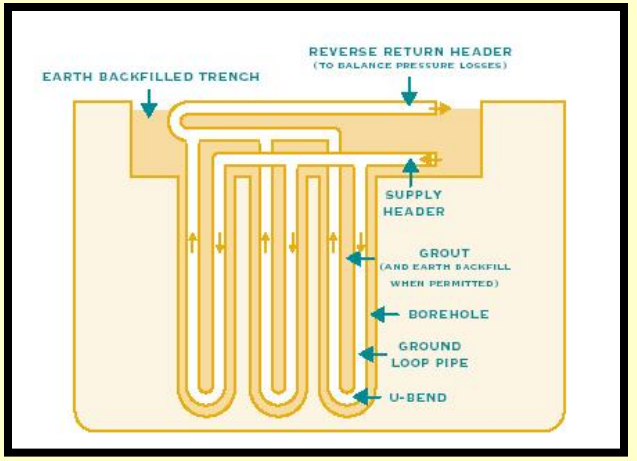


Mechanical Feasibility Study

Advantages

- Cut heating and cooling cost by 30-40%
- Durable long lasting
  - Protected from harsh outdoor weather conditions
- Fewer Mechanical Components
  - More Reliability
- Preservation of the environment by reducing the environmental impacts of electric power generation
- Takes advantage of earths constant temperature
  - Fluctuations of ambient air temperatures (chiller)
- Ability to move BTU's from one side of the building to the other

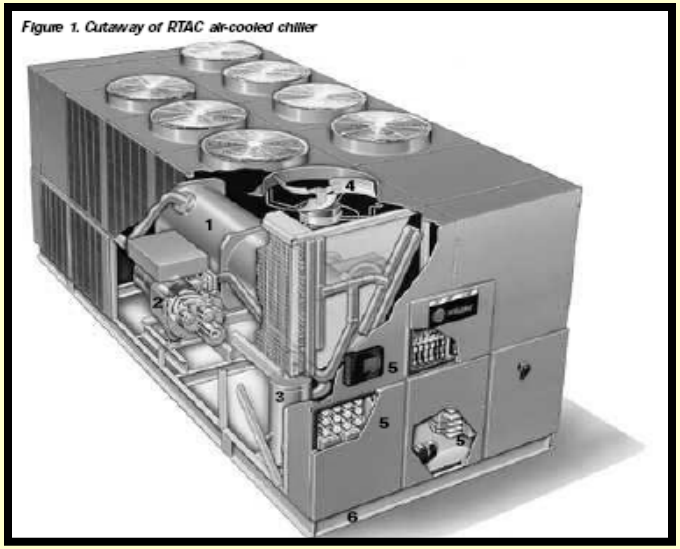


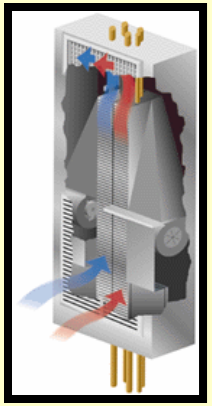


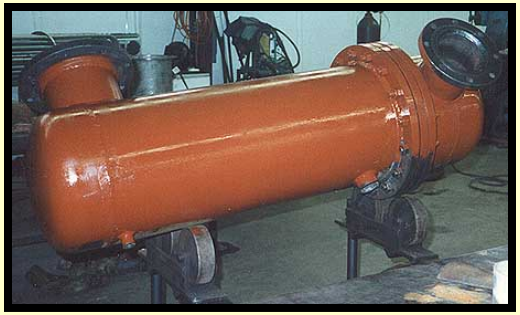
Mechanical Feasibility Study

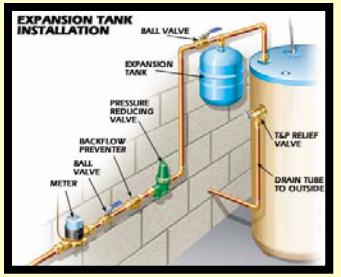
Equipment Elimination

- (1) Air- Cooled Helical Rotary Screw Chiller
- (2) Shell & Tube Steam-to-Water Converters
- (1) Duplex Condensate Receiver Pumpset
- (63) – 1 ton – 4 pipe fan coil units
- (26) – 2 ton – 4 pipe fan coil units
- (2) Heating Hot Water Pumps
- (1) Heating Hot Water Expansion Tank
- (1) Heating Hot Water System Bypass Water Filter
- (1) Heating Hot Water Filter
- (1) Cold Water Expansion Tank
- (1) Cold Water System Bypass Filter
- (1) Cold Water System Shot Feeder
- (650) ft - *approx(from rough take-off)* - of Heating Hot Water Supply Piping
- (650) ft - *approx(from rough take-off)* - of Heating Hot Water Return Piping









Mechanical Feasibility Study

Power Comparison

Mechanical System Power Comparison													
Current System							Proposed System						
Design	Equipment	EER	ton	kw	MBH	kw based on EER	kw based on EER	MBH	kw	EER	Equipment	Design
CH-1	Air-Cooled helical Rotary Screw Chiller	10.3	140	181	1680	163.1068	24.84	400	24.84	5.8 - C.O.P	Energy Recovery Air Handling Unit - Heat Pumps	ERU - HP
CONV-1	Steam Converter				2200							
CONV-2	Steam Converter				2200							
CR-1	Duplex Steam Condensate Reciever Pumpse	1		1.119	0	1.119						
FCU	4-Pipe Fan Coil Units	1		23.829	1238.6	23.829	83.6891892	1238.6	91.99	14.8	2-Pipe Water-to-Air Heat Pumps	H.P.
P-HW1	Htg Hot Water Pump	1		5.595	0	5.95						
P-HW2	Htg Hot Water Pump	1		5.595	0	5.95						
	Htg Hot Water Expansion Tank											
	Htg Hot Water System Bypass Water Filter											
	Htg Hot Water System Shot Feeder											
	Cold Water Expansion Tank											
	Cold Water System Bypass Water Filter											
	Cold Water System Shot Feeder											
TOTALS				217.14	7318.6	199.955	108.5292	1638.6	116.83			
						-163.1068						
				Winter Months		36.848						

FCU – Power used to operate fan, efficiency would be based off the equipment that is providing either chilled water

Mechanical Feasibility Study

Energy Bill

For FCU and Heat Pumps:

For 7 Day Week	
On-Peak	40hrs
Intermediate	40hrs
Off-Peak	88hrs

Demand KW

- **On-Peak (Summer Billing Months Only) - The billing demand shall be the maximum thirty (30)minute demand recoreded during the on-peak period of the billing month (202.5)**

- **Maximum (All Months) - The billing demand shall be the maximum thirty (30) minute demand recorded during the billing month (202.5)**

- **202.5 KW** = 270KW * 75%

Potomac Electric Power Company
District of Columbia
Standard Offer Service Rates
Effective February 8, 2005 Through May 31, 2006

TIME METERED GENERAL SERVICE - LOW VOLTAGE SCHEDULE "GT-LV"

CURRENT SYSTEM

Enter the kw for the desired system	199.954796	Billing Months of June-October		kw	Billing Months of November-May		kw
Generation				199.9547961			36.848
Kilowatt hour Charge							
	On Peak	$0.08682	per kwh	$694.40	$0.06889	per kwh	$101.54
	Intermediate	$0.06632	per kwh	$530.44	$0.07239	per kwh	$106.70
	Off Peak	$0.05645	per kwh	$993.30	$0.05757	per kwh	$186.68
Kilowatt Charge							
	On Peak	$0.84507	per kw	$171.13			
	Maximum	$0.30248	per kw	$61.25	$0.30248	per kw	$61.25
Transmission							
All kwh		$0.00111	per kwh	$37.29	$0.00111	per kwh	$6.87
Kilowatt Charge							
	On peak	$0.71000	per kw	$141.97			
	Maximum	$0.59000	per kw	$119.48	$0.59000	per kw	$119.48
Distribution							
Customer Charge		$20.93000	per month	$20.93000	$20.93000	per month	$20.93000
All kwh		$0.01029	per kwh	$345.67	$0.01029	per kwh	$63.70
Kilowatte Charge							
	Maximum	$4.80000	per kw	$972.00	$4.80000	per kw	$972.00
Delivery Tax		$0.00770	per kwh	$258.66	$0.00770	per kwh	$47.67
Public Space Occupancy Surcharge		$0.00154	per kwh	$51.73	$0.00159	per kwh	$9.84
Reliability Enegy Trust Fund		$0.00065	per kwh	$21.84	$0.00065	per kwh	$4.02
Generation Procurement credit		$0.00002	per kwh	$0.67	$0.00002	per kwh	$0.12
Sub-total				$4,420.74			$1,700.80
	Subtracting out the cost that are only added once to the monthly bill			-$171.13 -$61.25 -$141.97 -$119.48 -$20.93000 -$972.00			-$61.25 -$119.48 -$20.93000 -$972.00
Billing for average 7 day week less demand and peak charges				$2,933.99			$527.14
Billing for 1 month less demand and peak charges				$11,735.97			$2,108.57
Billing for 1 month of electrical service				$13,222.72			$3,282.22

Mechanical Feasibility Study

Energy Bill

For Heat Pumps:

- Ground source heat exchanger to charge the loop
- Not using fossil fuels or electricity to charge the loop
- Ability to take BTU's from or put BTU's into the loop
- Diversity Factor of 60%
- 65.1KW = 108.5 * 60%

Potomac Electric Power Company
District of Columbia
Standard Offer Service Rates
Effective February 8, 2005 Through May 31, 2006

TIME METERED GENERAL SERVICE - LOW VOLTAGE SCHEDULE "GT-LV"

PROPOSED SYSTEM

Enter the kw for the desired system	108.5	Billing Months of June-October		kw	Billing Months of November-May		kw
Generation				65.1			65.1
Kilowatt hour Charge							
	On Peak	$0.08682	per kwh	$226.08	$0.06889	per kwh	$179.39
	Intermediate	$0.06632	per kwh	$172.70	$0.07239	per kwh	$188.50
	Off Peak	$0.05645	per kwh	$323.39	$0.05757	per kwh	$329.81
Kilowatt Charge							
	On Peak	$0.84507	per kw	$171.13			
	Maximum	$0.30248	per kw	$61.25	$0.30248	per kw	$61.25
Transmission							
All kwh		$0.00111	per kwh	$12.14	$0.00111	per kwh	$12.14
Kilowatt Charge							
	On peak	$0.71000	per kw	$46.22			
	Maximum	$0.59000	per kw	$119.48	$0.59000	per kw	$119.48
Distribution							
Customer Charge		$20.93000	per month	$20.93000	$20.93000	per month	$20.93000
All kwh		$0.01029	per kwh	$112.54	$0.01029	per kwh	$112.54
Kilowatte Charge							
	Maximum	$4.80000	per kw	$972.00	$4.80000	per kw	$972.00
Delivery Tax		$0.00770	per kwh	$84.21	$0.00770	per kwh	$84.21
Public Space Occupancy Surcharge		$0.00154	per kwh	$16.84	$0.00159	per kwh	$17.39
Reliability Enegy Trust Fund		$0.00065	per kwh	$7.11	$0.00065	per kwh	$7.11
Generation Procurement credit		$0.00002	per kwh	$0.22	$0.00002	per kwh	$0.22
Sub-total				$2,346.24			$2,104.97
	Subtracting out the cost that are only added once to the monthly bill			-$171.13 -$61.25 -$46.22 -$119.48 -$20.93000 -$972.00			-$61.25 -$119.48 -$20.93000 -$972.00
Billing for average 7 day week less demand and peak charges				$955.23			$931.31
Billing for 1 month less demand and peak charges				$3,820.92			$3,725.24
Billing for 1 month of electrical service				**$5,211.93**			**$4,898.90**

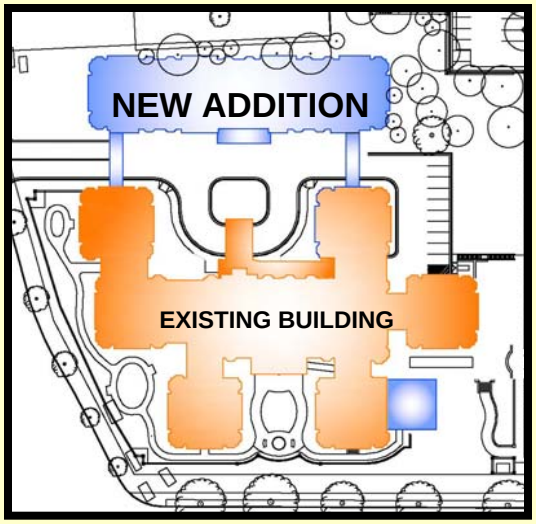
Mechanical Feasibility Study - Conclusion

Power Consumption	Current System	Proposed Geo-thermal
Maximum Input	217.138 KW	160.875 KW
Based on E.E.R.	199.955 KW	108.529 KW
Summer W/ Diversity Factor	199.955 KW	65.100 KW
Winter W/ Diversity Factor	36.848 KW	65.100 KW

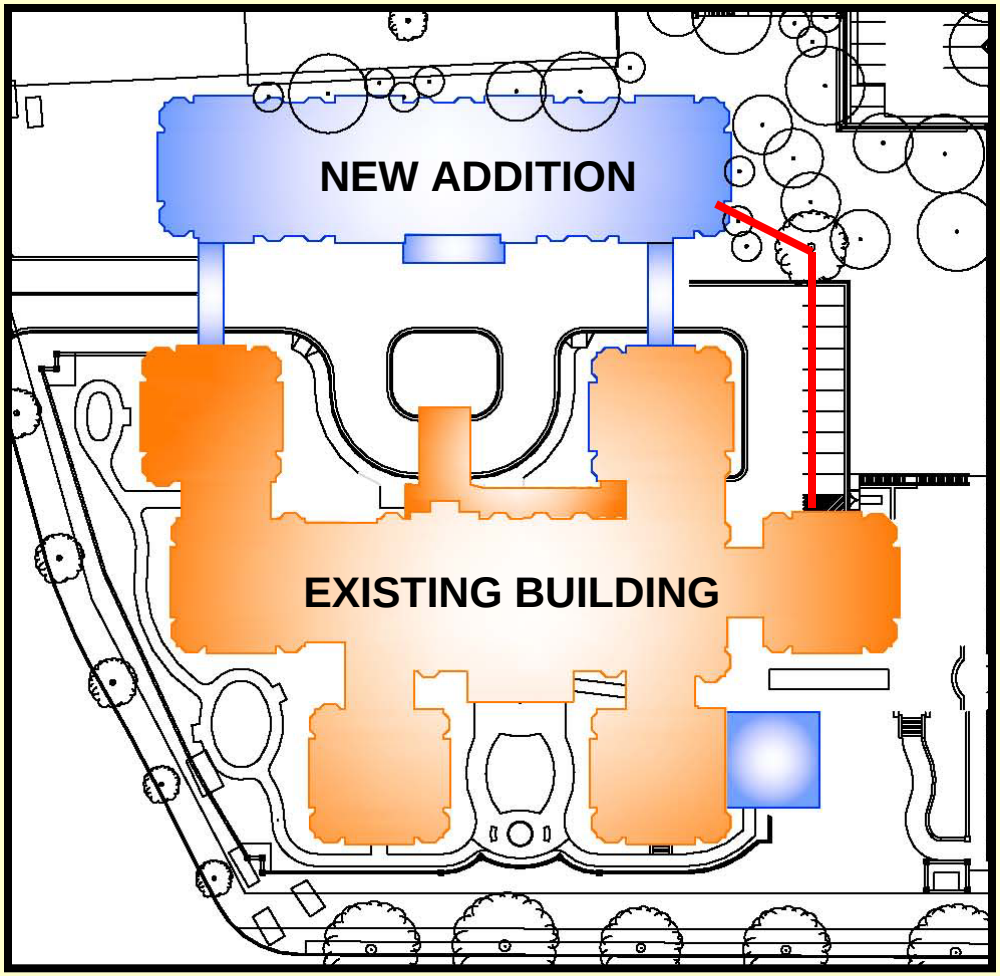
Electric Bills	Current System	Proposed Geo-thermal
Summer Billing Months	$ 13,222.72	$ 5,211.93
Winter Billing Months	$ 3,282.22	$ 4,898.90

Electrical Depth

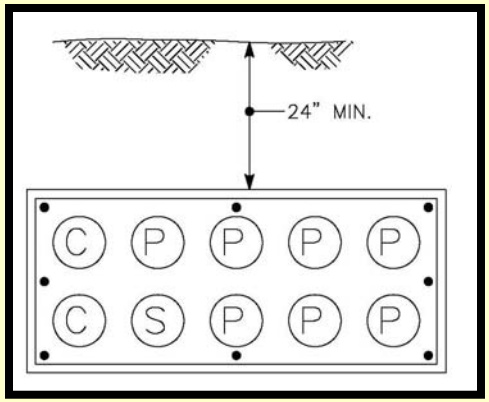
- New Distribution Method



Electrical Depth Study – Current System

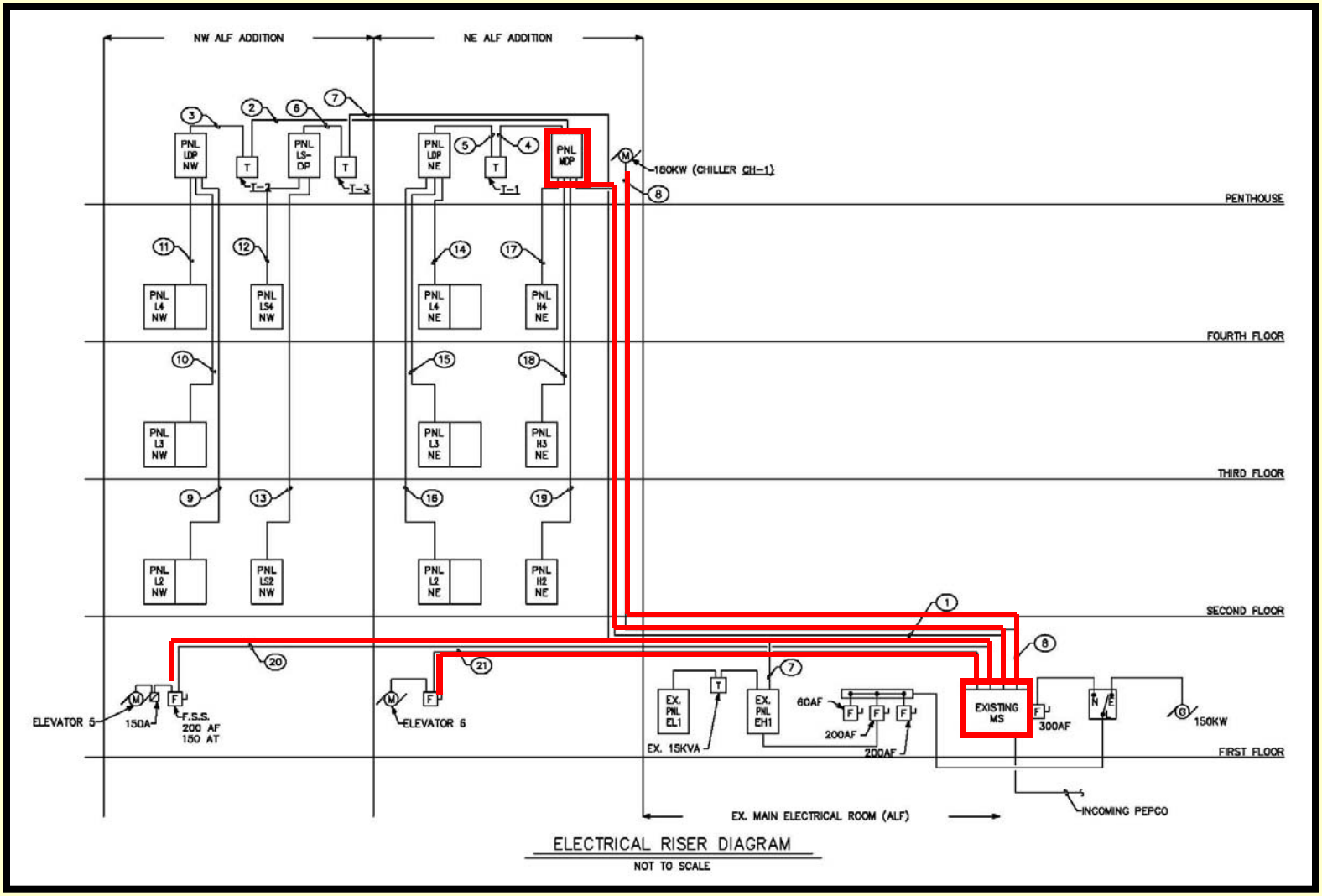


2x5 Electrical Ductbank

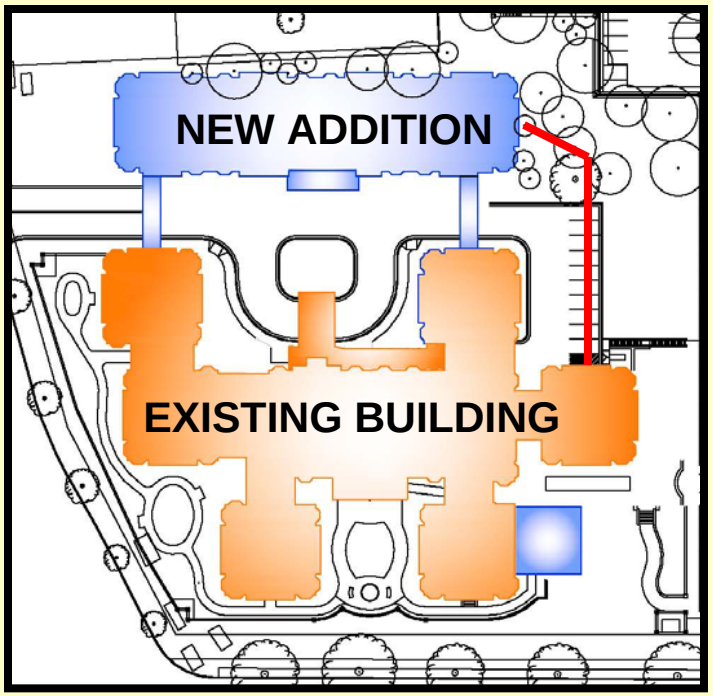


Conductors	Serving
- (2) Sets 4#500MCM	600A -MDP
- (2) Sets 3#250MCM	180 KW-Chiller
- 3#3/0	Elevator #5
- 3#3/0	Elevator #6

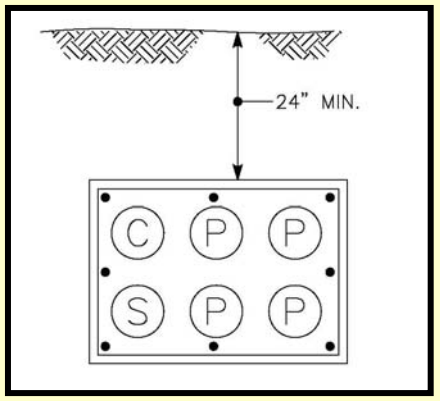
Electrical Depth Study – Current System Riser Diagram



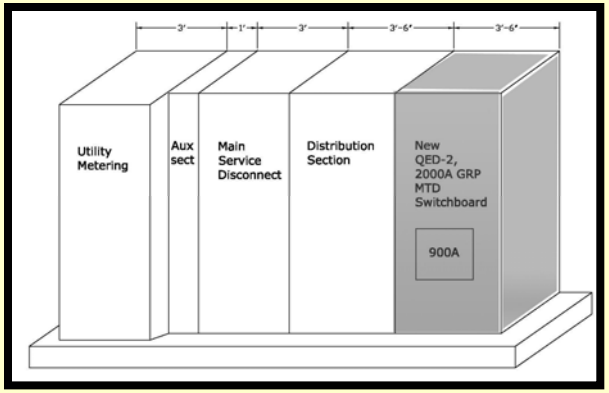
Electrical Depth Study – Proposed Design



2x3 Electrical Ductbank

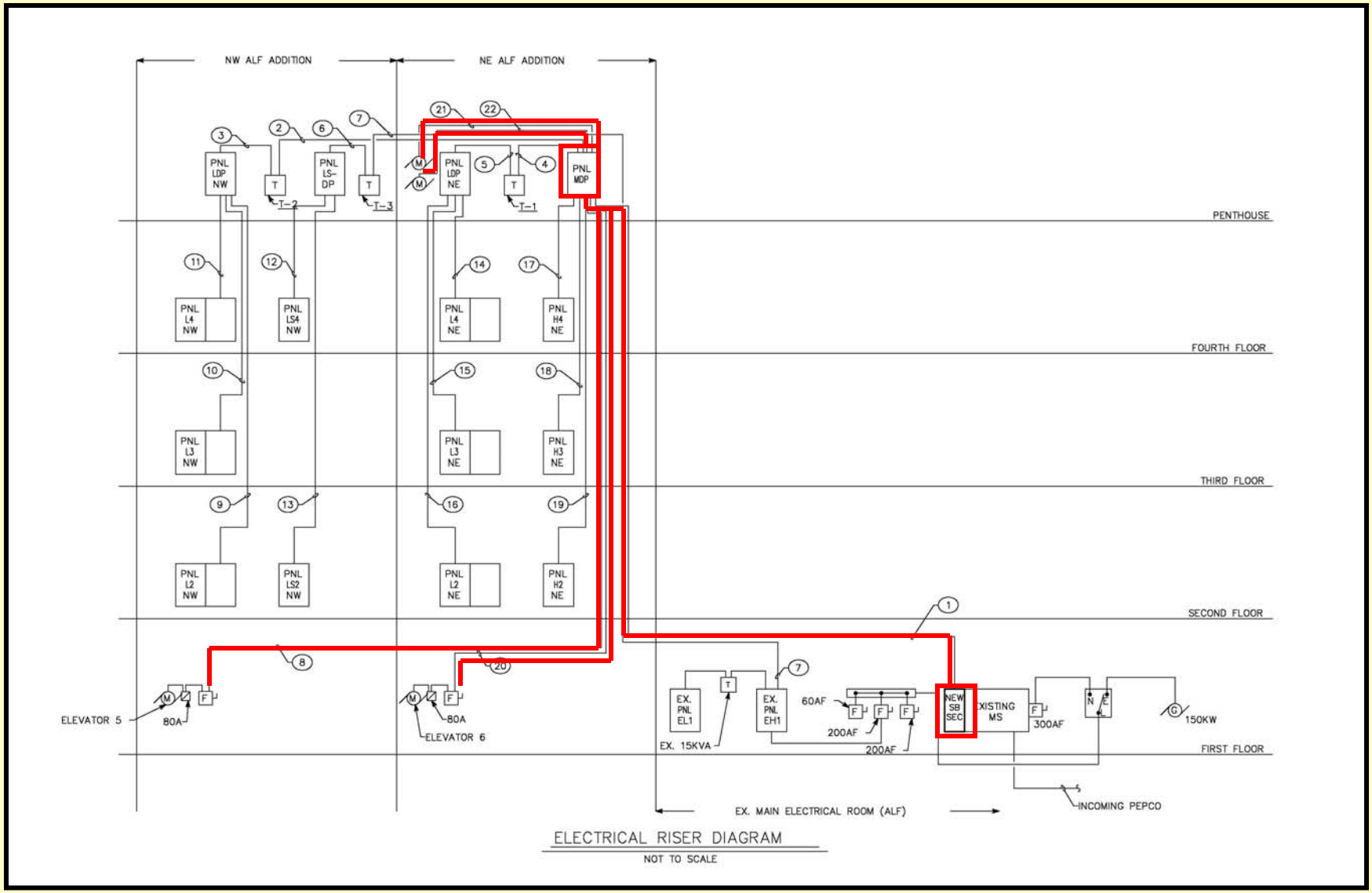


Conductors	Serving
- (3) Sets 4#350MCM	900A -MDP
- 3#3	Elevator #5
- 3#3	Elevator #6
- 3#8	HP-1-ERU
- 3#8	HP-1-ERU



2000A Switch Board with 2000A horizontal bus, 2000A vertical bus. Provide QED-2, 2000A Group Mounted Switch Board, Floor Mounted

Electrical Depth Study – *New* Riser Diagram



Electrical Depth Study – Cost Comparison

Current System

Breakers (3-phase) 16410|Encl Switches & Circuit Breakers		Size (A)	Quanity	Cost/unit	Cost	Total Incl. O&P
	220|0600	150	2	$4,100	$8,200	$9,929.10
	200|0700	350	1	$4,600	$4,600	$5,761.50
	200|0800	600	1	$6,400	$6,400	$7,986.75
					Subtotal	$23,677.35
MDP 16440|Swbds, Panels & Control Centers		Size (A)	Quanity	Cost/unit	Total	Total Incl. O&P
	820|0900	600	1	$4,000	4808.15	$4,808.15
Feeders 16120|Conductors & Cables		Wire	Quanity	Length	Total/C.L.F	Total Incl. O&P
	900|0490	500 MCM	8	400	624	$24,480.00
	900|0400	250 MCM	3	400	379	$5,760.00
	900|0300	3/0.	6	400	276	$8,520.00
	900|0240	#1	4	400	161.5	$3,344.00
	900|0200	#3	2	400	115	$1,216.00
					Subtotal	$43,320.00
Ductbank 16132|Conduit in Trench		240|1000	Quanity	Length	Total/L.F	Total Incl. O&P
Includes terminations and fittings does not include excavation or backfill, see div. 02315		4" diameter	60" wide	400	415	$166,060.00
4" conduit in a duct bank is an industry standard, therefore that is what was used in the cost comparison					Total Cost	$237,865.50

Proposed System

Breakers (3-phase) 16410|Encl Switches & Circuit Breakers		Size (A)	Quanity	Cost/unit	Cost	Total Incl. O&P
	900A-trip	1000	1	$14,000	$14,800	$17,020.00
		40	2	$1,088	$2,380	$2,737.00
					Subtotal	$19,757.00
MDP 16440|Swbds, Panels & Control Centers		Size (A)	Quanity	Cost/unit	Total	Total Incl. O&P
	820|0900	1000	1	$8,000	$8,410	$9,200
Switchboard Section 16440|Swbds, Panels & Control Centers		Size (A)	Quanity	Cost/unit	Total	Total Incl. O&P
	840|5000	2000	1	$9,950	$10,910	$12,000
Feeders 16120|Conductors & Cables		Wire	Quanity	Length	Total/C.L.F	Total Incl. O&P
	900|0450	350 MCM	12	400	478	$28,560.00
	900|0280	2/0.	3	400	230	$3,552.00
	900|0200	# 3	6	150	110	$1,217.40
	900|140	# 8	8	200	50.3	$1,080.00
	900|120	#10	2	50	50	$50.00
					Subtotal	$34,459.40
Ductbank 16132|Conduit in Trench		240|1000	Quanity	Length	Total/L.F.	Total Incl. O&P
Includes terminations and fittings does not include excavation or backfill, see div. 02315		4" diameter	36"	400	253	$101,200.00
4" conduit in a duct bank is an industry standard, therefore that is what was used in the cost comparison					Total Cost	$176,616.40

Proposed System Saves approx. $61,249.00

Cost Analysis of Geothermal Heat Pumps

Construction Management Breadth – Cost Comparison

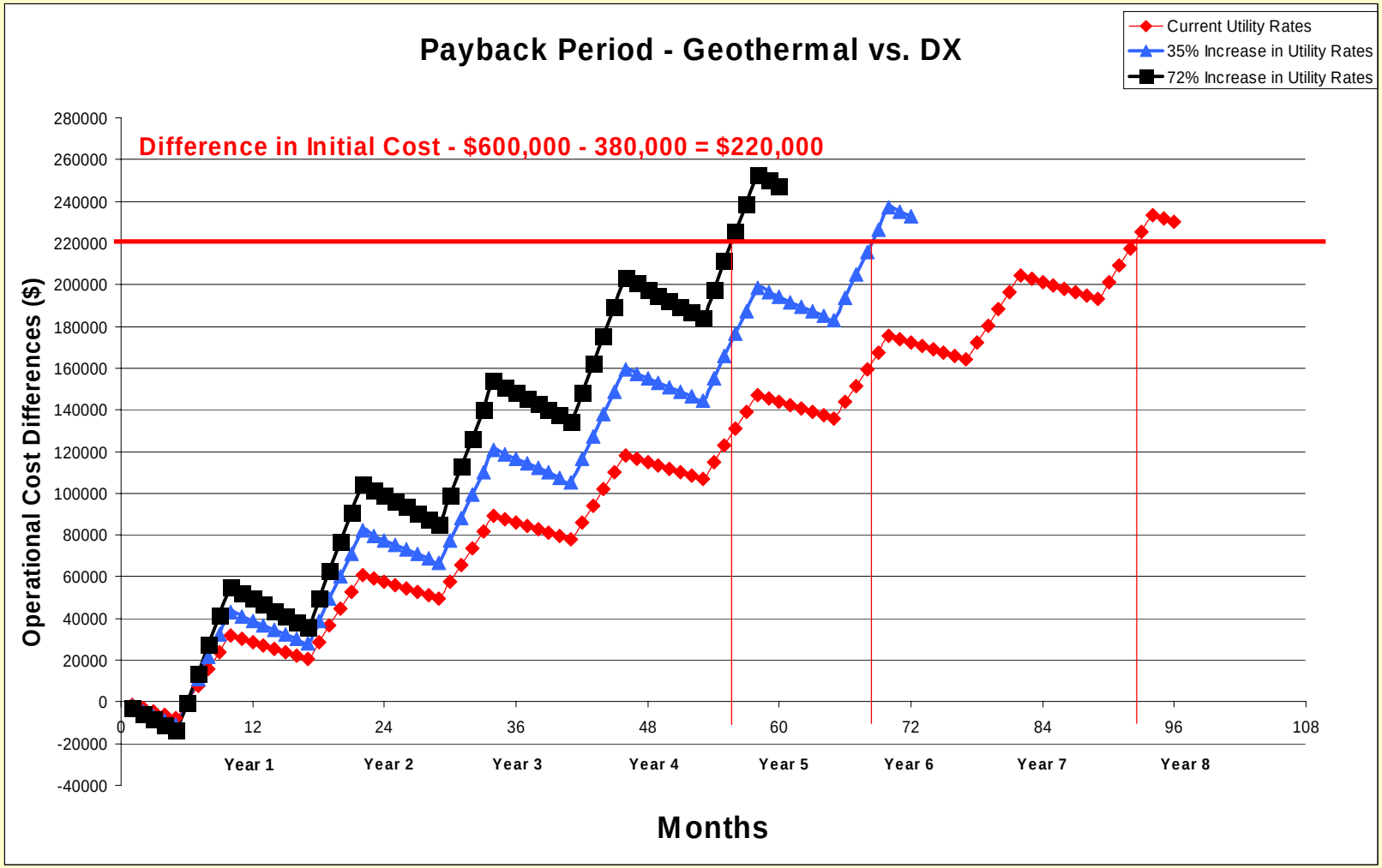
Current System								
Designation	Equipment	Quanity	Size	Division	section number	Discription		
							Length	TOTAL
CH-1	Air-Cooled helical Rotary Screw Chiller		140 TON	**15620| Package Water Chillers**	600|1200	140 ton cooling, Water cooled, dual compressors, direct drive		78500
CONV-1	Steam Converter		220 GPM	**15710|Heat Exchangers**	900|3100	220 GPM		10200
CONV-2	Steam Converter		220 GPM	**15710|Heat Exchangers**	900|3100	220 GPM		10200
CR-1	Duplex Steam Condensate Reciever Pumpset	2	1-1/2 HP	**15180|Heating and Cooling Piping**	300|1000	Duplex, 2 pumps, float switch, alternator assembly, 15 Gal. C.I. reciever		14100
FCU	4-Pipe Fan Coil Units	63	1-ton	**15760|Terminal Heating & Cooling Units**	300|0120	Fan Coil, Cabinet mounted, filters, controls		52920
FCU	4-Pipe Fan Coil Units	26	2-ton	**15760|Terminal Heating & Cooling Units**	300|0150	Fan Coil, Cabinet mounted, filters, controls		173550
P-HW1	Htg Hot Water Pump		7-1/2 HP	**15400|Plumbing Pumps**	240|0480	Pump System, with diapragm tank, control, press. switch	-	6675
P-HW2	Htg Hot Water Pump		7-1/2 HP	**15400|Plumbing Pumps**	240|0480	Pump System, with diapragm tank, control, press. switch	-	6675
ET-HW	Htg Hot Water Expansion Tank		60 Gallons	**15120|Piping Specialties**	320|2080	60 gallon capacity		750
BF-HW	Htg Hot Water System Bypass Water Filter							0
SF-HW	Htg Hot Water System Shot Feeder							0
ET-CW	Cold Water Expansion Tank		24 Gallons	**15120|Piping Specialties**	320|2020	24 gallon capacity		470
BF-CW	Cold Water System Bypass Water Filter							0
SF-CW	Cold Water System Shot Feeder							0
Piping Return	Htg Hot Water Return Piping - Assume 2" throughout		2"	**15107|Metal Piping and Fittings**	620|0610	Metal Piping & Fittings	653	11982.55
Piping Supply	Htg Hot Water Supply Piping - Assume 2" throughout		2"	**15107|Metal Piping and Fittings**	620|0610	Metal Piping & Fittings	653	11982.55
						Total System Cost		**$380,000.00**

Construction Management Breadth – Cost Comparison

Proposed System								
Designation	Equipment	Quanity	Size	Division	section number	Discription	Length	TOTAL
HP	Heat Pumps	64	1 ton	15740|Heat Pumps	800|2100	Water source to air		99200
HP	Heat Pumps	12	2 ton	15740|Heat Pumps	800|2140	Water source to air		21000
HP	Heat Pumps	14	5 ton	15740|Heat Pumps	800|2220	Water source to air		40250
HP-ERU	Heat Pumps	2	20 ton	15740|Heat Pumps		water-to-water		9360
Drilling Cost	All equimpent rentals embedded in cost, as well as grouting, piping, and backfill material		200 ton				160	140800
						Subtotal		310610
Overall Installation Cost(based on professional estimate)			60000 sqft					
						Total System Cost		$600,000.00

Current System	Initial Cost	Energy Use(Summer) kw	Energy Use(Winter) kw	Summer Bill	Winter Bill	Annual Electric Bill
Air Cooled, Rotary Screw Chiller, Fan Coil Units	$380,000.00	199.9547961	36.848	$66,113.61	$22,975.56	$89,089.18
Proposed System	Initial Cost	Energy Use(Summer) kw	Energy Use(Winter) kw	Summer Bill	Winter Bill	Annual Electric Bill
Heat Pumps with Geothermal Loop	$600,000.00	65.1	65.1	$26,059.63	$34,292.29	$60,351.92
Cost/Usage Difference	**$220,000.00**	**-134.85**	**28.25**	**-$40,053.98**	**$11,316.72**	**-$28,737.26**

Construction Management Breadth – Cost Comparison



Construction Management Breadth – Cost Comparison

Current Electric Rate					
Annual Savings	Uniform Series Present Worth Factor	Annual Interest or Discount Rate	Term Years	Present Worth	
$ 30,000	11.14694586	7.500%	25	$	334,408
$ 30,000	10.67477619	8.000%	25	$	320,243
$ 30,000	9.077040018	10.000%	25	$	272,311
$ 30,000	7.843139112	12.000%	25	$	235,294
$ 30,000	7.579005012	12.500%	25	$	227,370
$ 30,000	7.329984978	**13.000%**	25	$	219,900

Present Value Of Savings	**$334,408.00**
Less Initial Investment	**- $220,000.00**
Net Present Value	**$114,408.00**
Rate of Return	**~ 13%**

Project Life of Geothermal System ~ 25 years

Mark W. Miller

Questions?
Fragen?

Grand Oaks Assisted Living Facility

Mark W. Miller