

NEOMED Research and Graduate Education Building + Comparative Medical Unit Expansion

the Northeast Ohio Medical University Campus Rootstown, Ohio

Image © <www.neomed.edu

Sam Bridwell, BAE

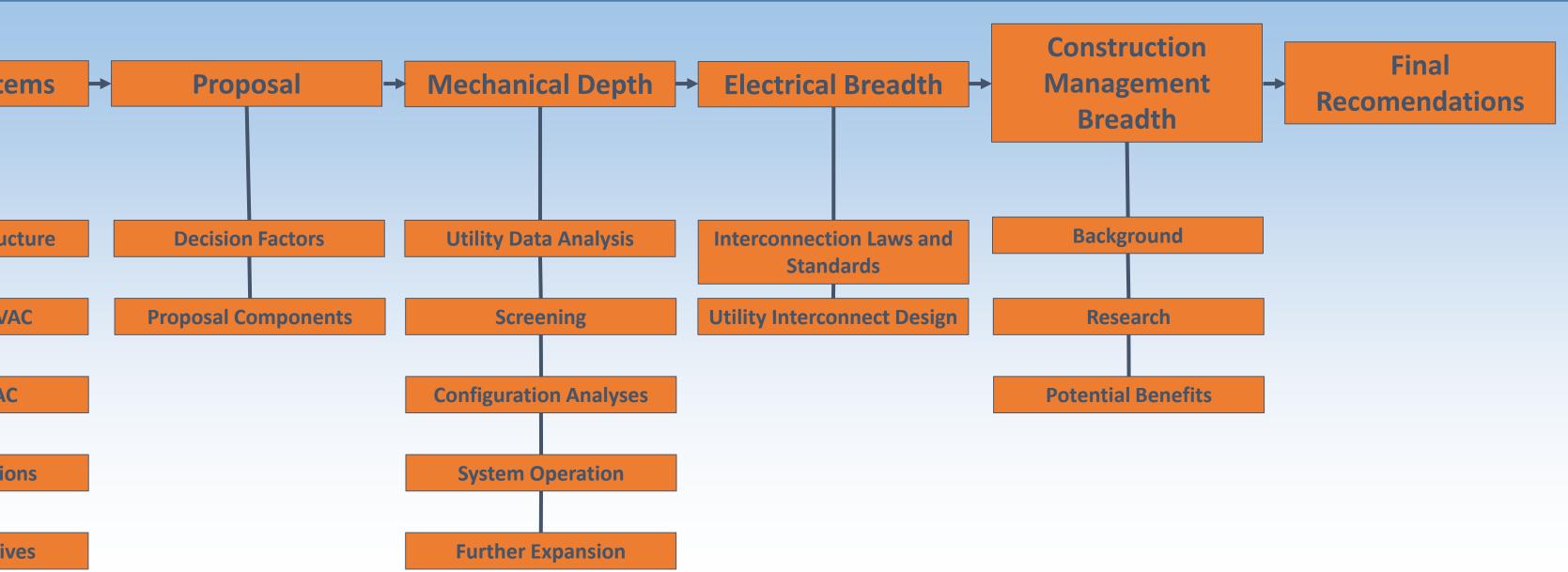


Image © <www.crvstaldiagnostics.com

Mechanical Option Advisor: Dr. Freihaut

- Introduction
- Project Overview
- Existing Systems
- Proposal
- Depth: Cogeneration Plant Implementation
- Breadth 1: Power Interconnect and Black Start Capability
- Breadth 2: Alternate Project Delivery System
- Final Recommendations
- Conclusion/Acknowledgements

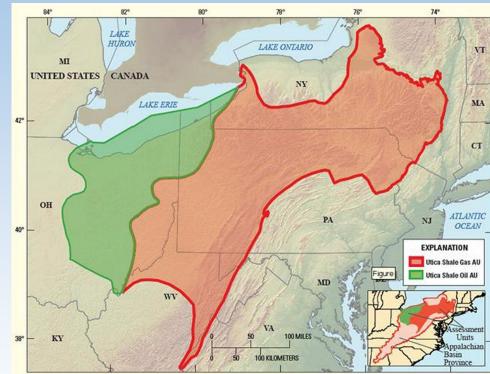
Project Overview	Existing System
	Existing Infrastru
	Water-side HV
	Air-side HVA
	Design Conditio
	Design Objectiv



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Project Location





Utica Shale Region

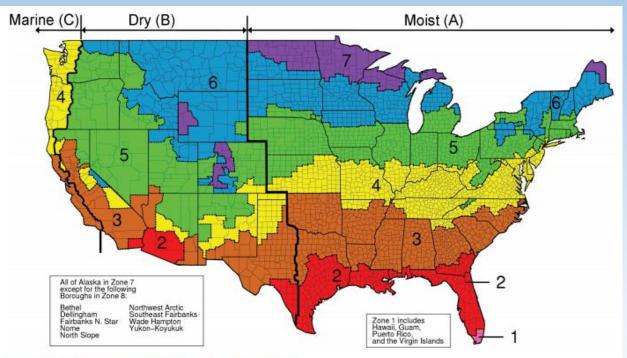


Figure B1-1 U.S. climate zone map (ASHRAE Transactions, Briggs et al., 2003).

Image © ASHRAE Std. 90.1.5.1.4 Figure B1-1



Cool and Moist

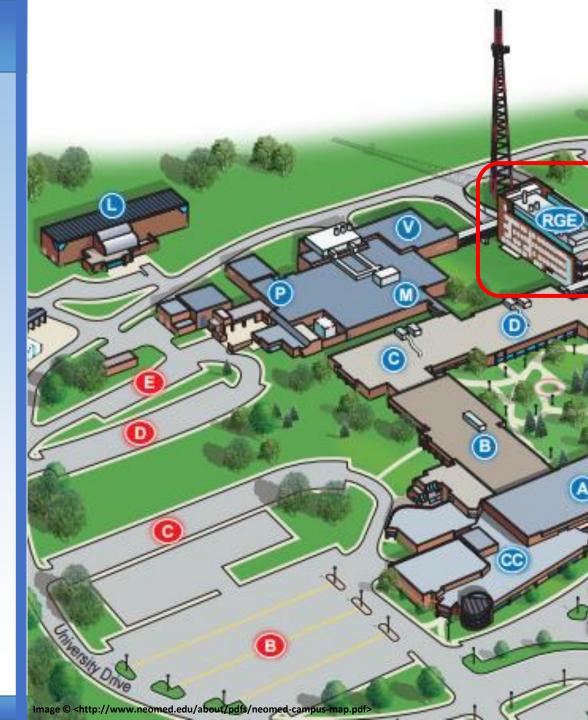
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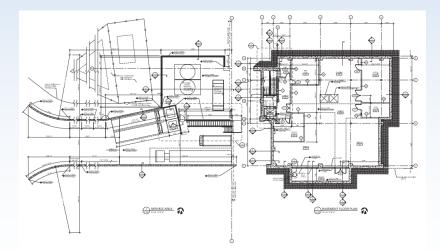
Research and Graduate Education Building



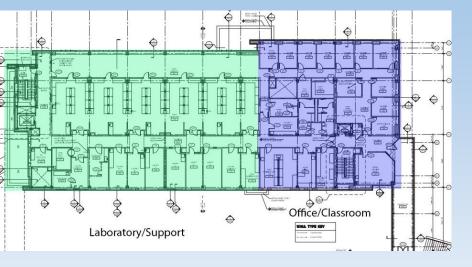
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VISITOR

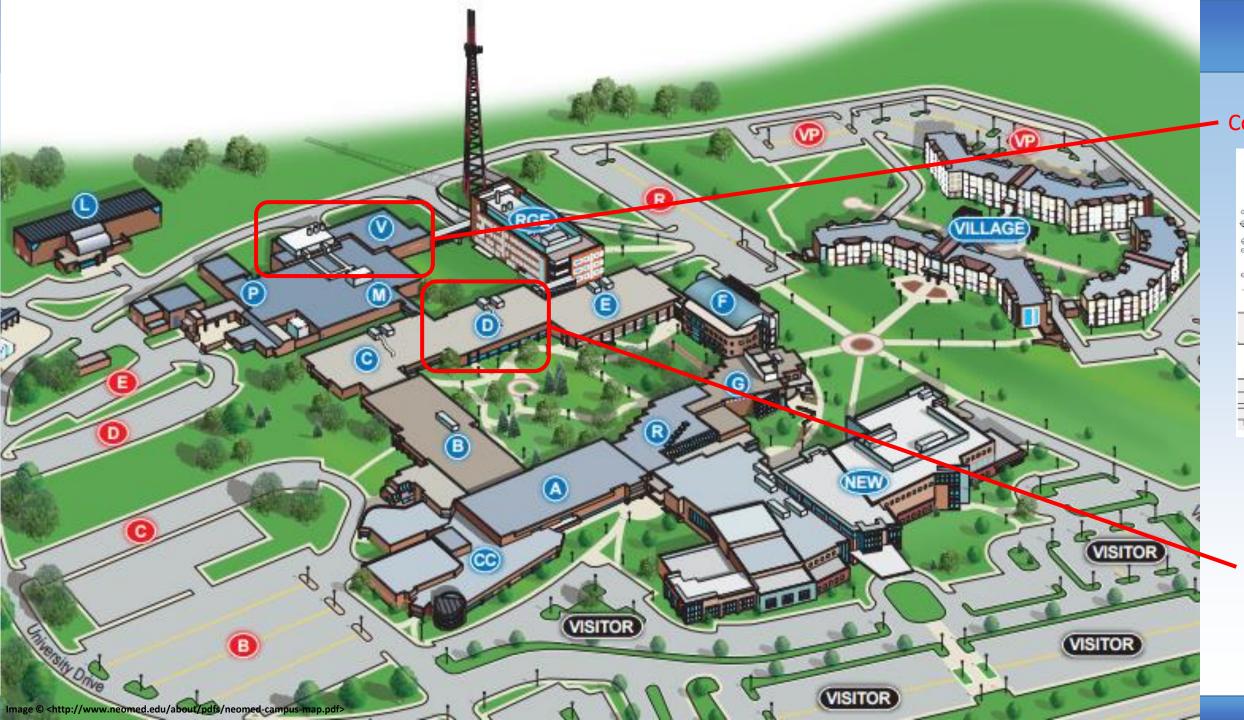
ISITOR





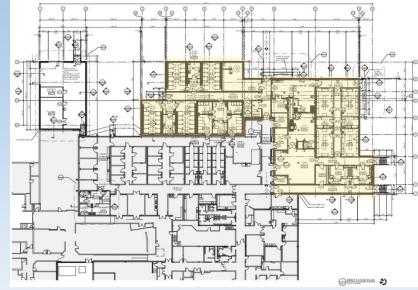


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- Comparative Medical Unit Expansion



REDI-Zone





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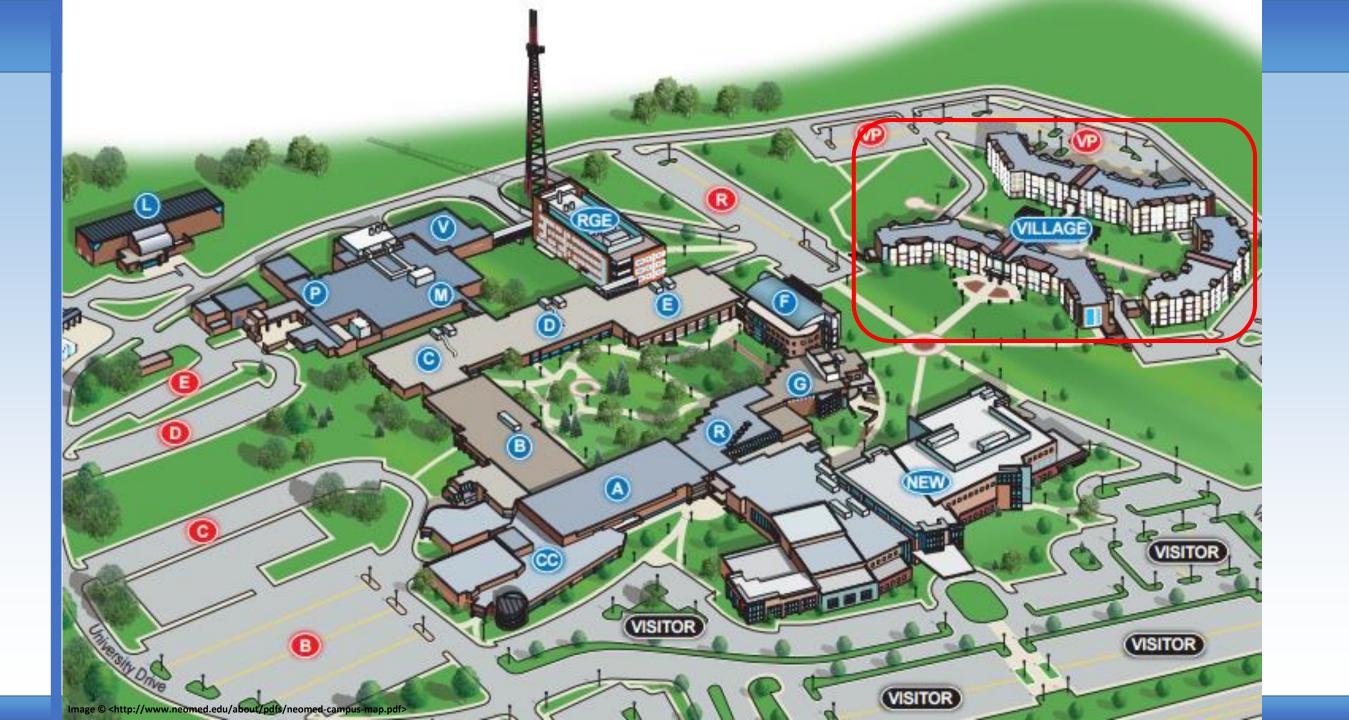






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VISITOR

ISITOR



NEOMED Education and Wellness Center





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<u>structure</u>

• Main HW/CW Plant

• High-Pressure Steam Plant

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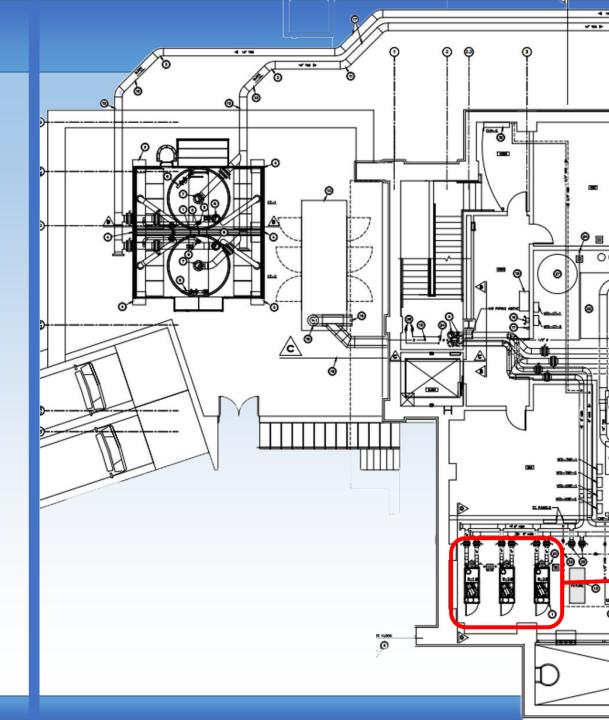






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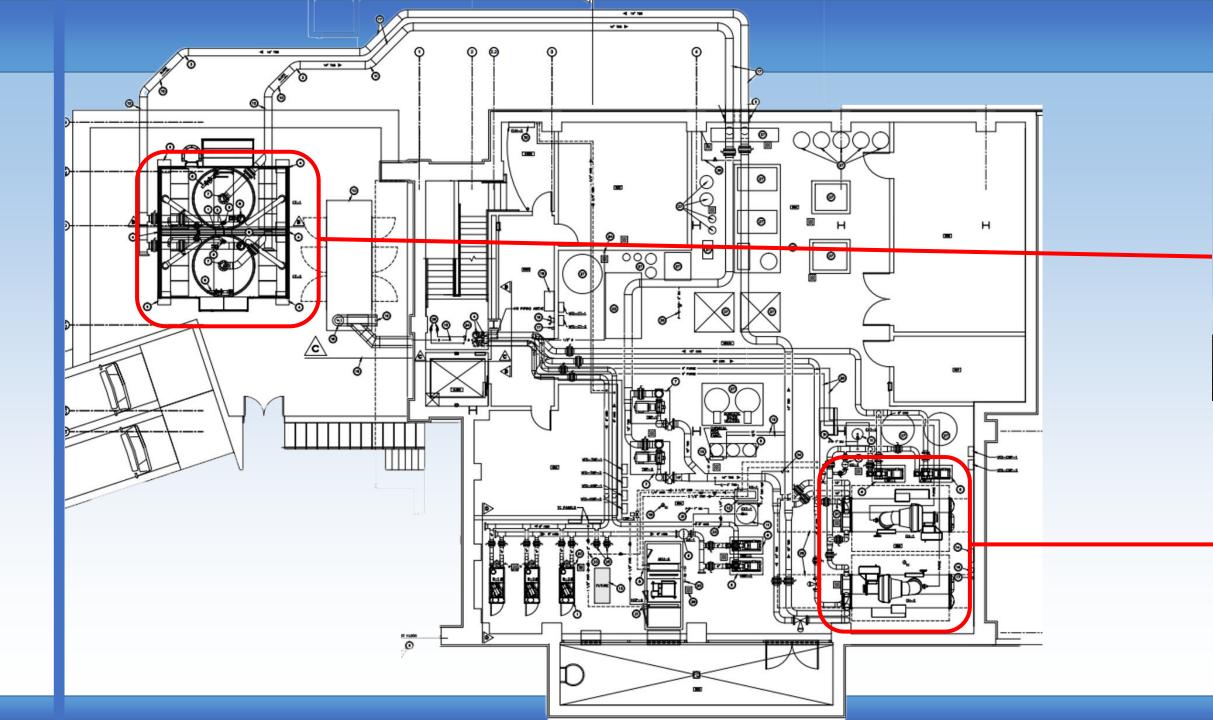






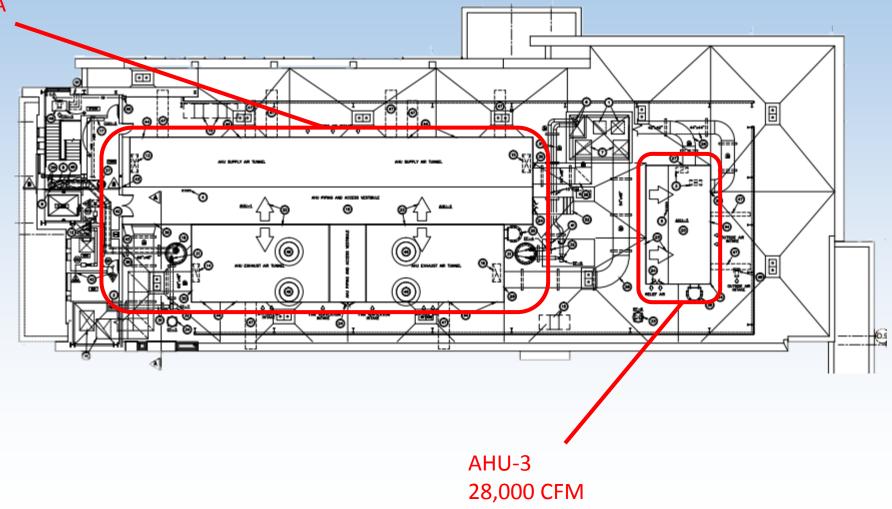
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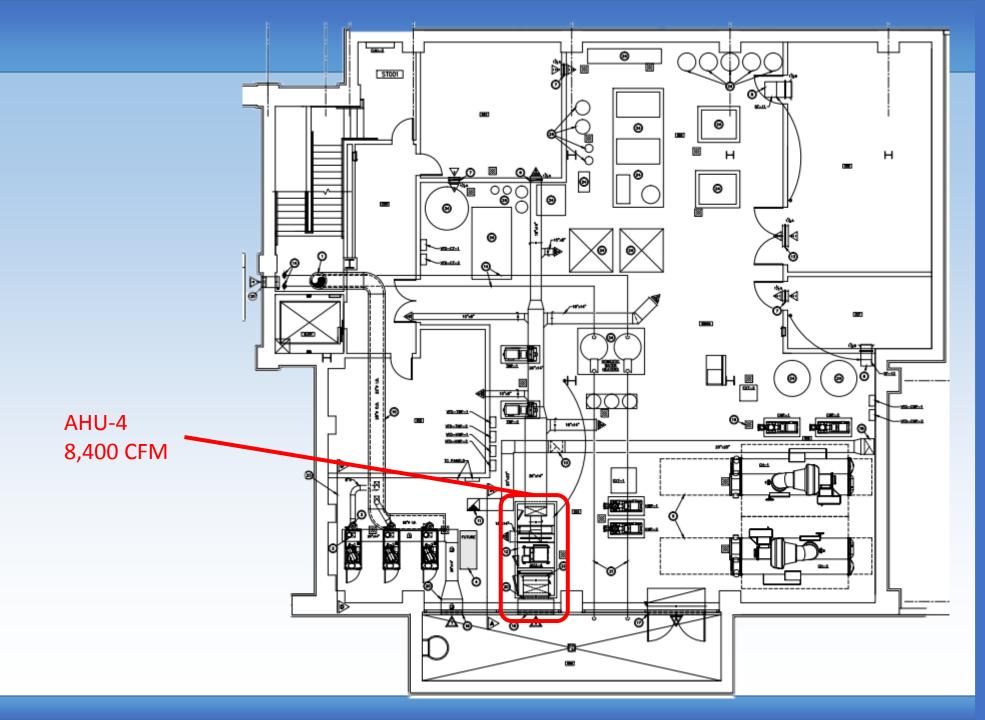


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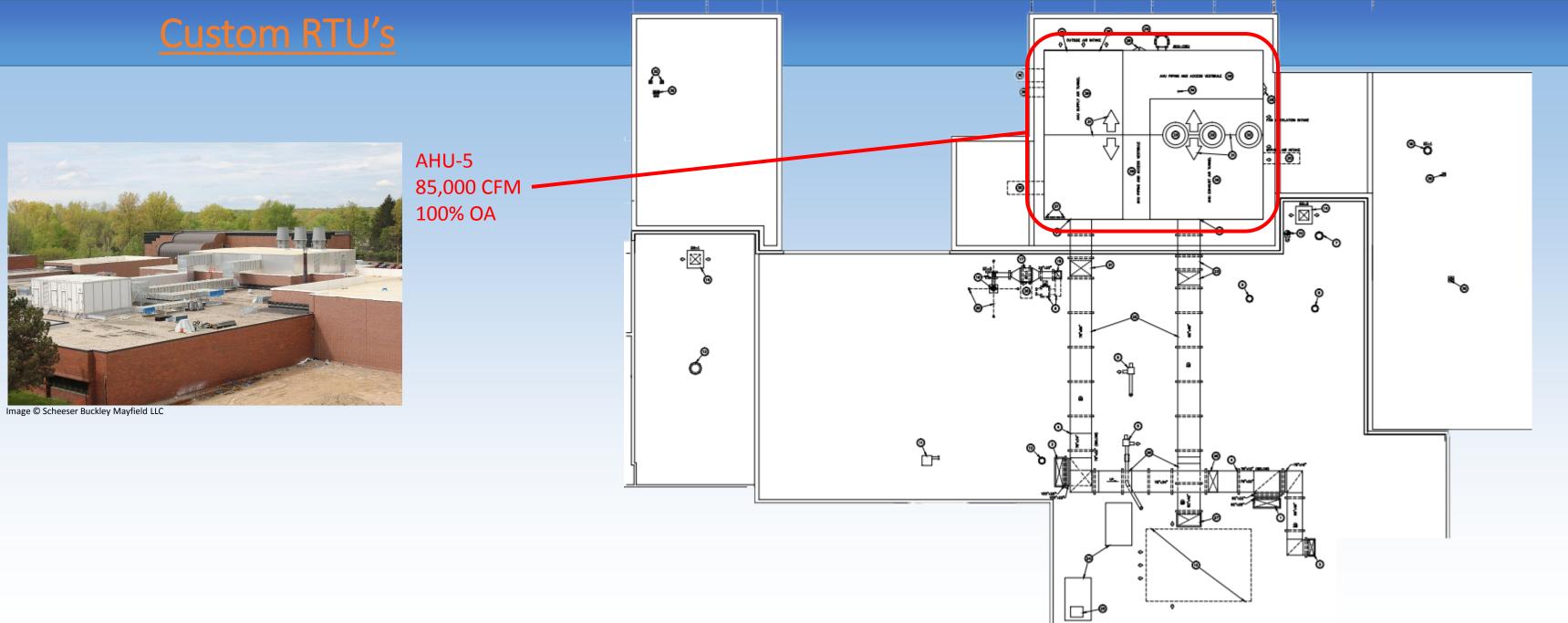


Custom RTU's



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1)	Filtration	Levels

1) <u>Filtration Levels</u>	Winter °F Summer °F (±2°F)
(a) Supply air tunnel to have MERV-9 pre-filter and MERV-14 after filter within AHU (serving new and existing Vivarium).	Exterior Design Temp. 0 89°db /73°wb Interior Design Temp.
(b) Room side replaceable "Filter Grilles" to be utilized for holding room exhaust.	Laboratories / support spaces 72 72 Mechanical/Electrical Rooms 65 Vent Only
(c) Heat pipe energy recovery (within exhaust) to have MERV-9 pre-filters.	Animal Holding Rooms68-8568-85 (Selectable range)Rabbits Holding Room6565Supply Air Temperature (at48°F db48°F db /47.5° wb
2) Chilled Water Design: 42°F EWT, 58°F LWT	discharge of chilled water coil) Vivarium Humidity
3) Hot Water Design: 160°F EWT, 120° LWT	Lab / Support spaces 35%±5 50% (±5%) Vivarium 30-40%±5 50% (±5%)
4) Steam System Design: 60 psig – process (Autoclaves + Cagewasher) 15 psig – (Humidification) reduced by new PRV	Image © BR+A Consulting Engineers
Image @ RP+A Consulting Engineers	

Image © BR+A Consulting Engineers

 The HVAC systems and equipment shall be designed in accordance with the following Ventilation / Pressurization / Cooling criteria: 1) Laboratories and support spaces Exhaust: 100% Exhaust. Air Circulation: As required by air conditioning load or equipment ventilation load. Min. 6 ACH/HR. Negative in relation to corridors and office spaces Pressure: Electrical Loads: 10 w/sf power, 2 w/sf lighting 2) Toilets/Janitors Closets Exhaust: 100% Exhaust 10 ACH exhaust (min.), constant volume Air Circulation: Pressure: Negative to adjacent spaces Electrical Loads: 1.5 w/sf lighting, convenience outlets Animal Holding MERV-9 Exhaust: Minimum 15 ACH, constant volume Air Circulation: Pressure: Negative to adjacent spaces Electrical Loads: 10 w/sf power, 1.5 w/sf lighting 4) Procedure Room 100% Exhaust Exhaust: 15 ACH minimum, as required for equipment makeup ventilation Air Circulation: Load, constant volume Negative to adjacent spaces Pressure: Electrical Loads: 15 w/sf power, 2 w/sf lighting 5) Operating Rooms Exhaust: 100% Exhaust 15 ACH minimum, as required for cooling Air Circulation: Positive Pressure: 15 w/sf power; 2 w/sf lighting Electrical Load: Airlocks 100% Exhaust Exhaust: Air Circulation: 10 ACH minimum, constant volume Negative to adjacent spaces Pressure: Electrical Loads: 1.5 w/sf lighting 7) Corridors 100% Exhaust Exhaust: Air Circulation: Minimum 6 ACH or requirement for make-up due to labs being at negative pressure. Positive to Laboratories Pressure: Electrical Loads: 1.5 w/sf lighting 8) Environmental Rooms 100% Exhaust Exhaust: Air Circulation: 20 CFM ventilation only

Neutral Pressure:

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Design Objectives

Top-Notch Quality of Facility

24/7 Availability for Staff and Researchers

Independence and Reliability of Building Systems

Flexibility for Future Changes and Campus Expansion



Image © <http://www.transactbookkeeping.co.uk/images/reliability.jpg>

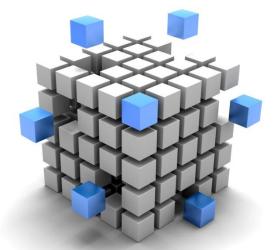
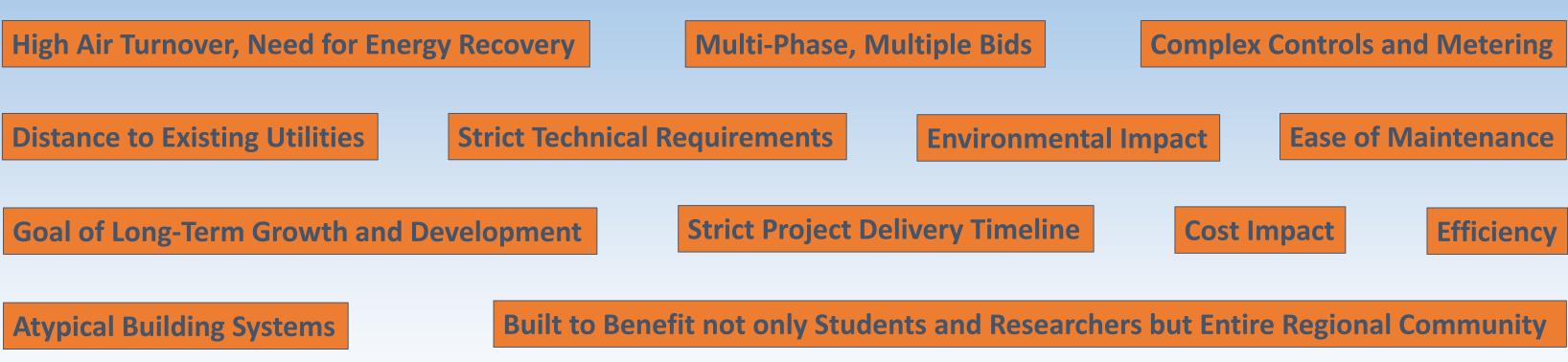


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Distance to Existing Utilities

Atypical Building Systems



Ease of Maintenance

Efficiency

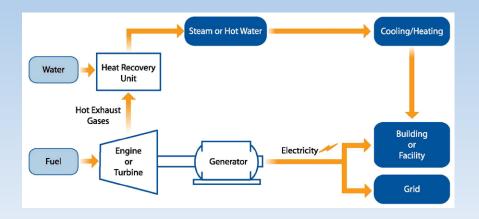
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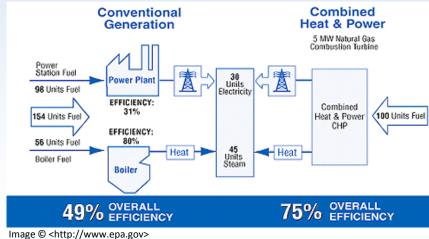
Breadth 1: Power Interconnect & Black Start Capability



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Depth: Cogeneration Plant Implementation





Breadth 2: Alternate Project Delivery System

Design-Build

Designs

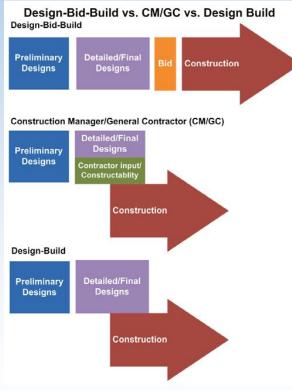


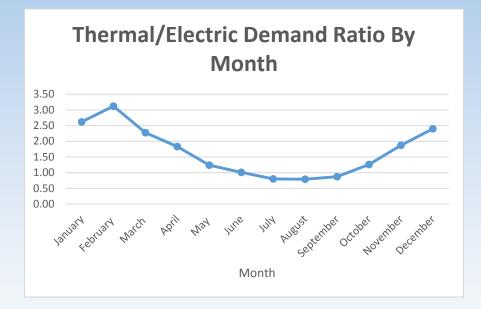
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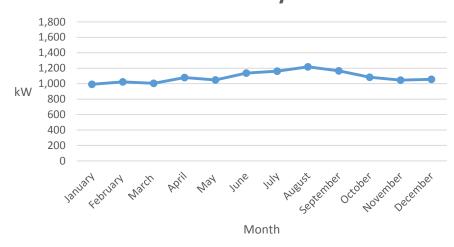
		Year
	Kilowatt Hrs	823,121
Month	Dollars	\$62,575.46
	\$/kwh	\$0.076
	Temperature	74°

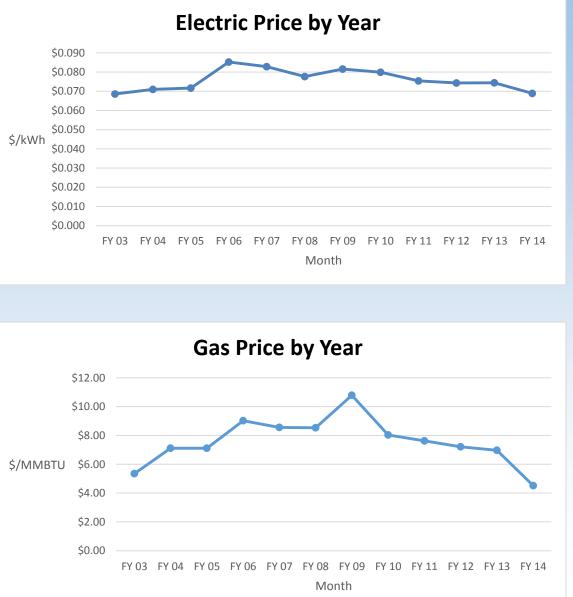
		Year		
M onth	MCF's	2,139.01		
	Dollars	\$16,962.35		
	\$/MMBTU	\$7.93		
	Temperature	74°		

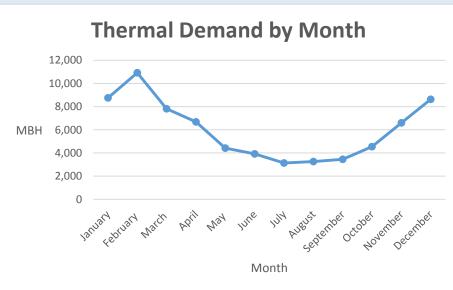
Yearly Average	\$/kwh	\$0.077
	\$/MMBTU	\$7.85
	Spark Gap	\$14.60
	kW	1084
	MBH	6010
	λD	1.63
	Temperature	

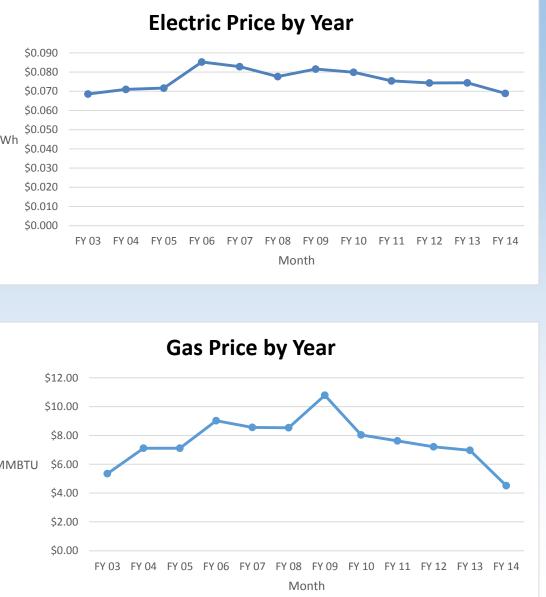


Electric Demand by Month









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Site Data Collection

1. How many hours per year does the facility operate? (hours) Or, ask about operating schedule - day/week, hours/day

- 2. What is your average power demand during operation? (kW), or
- 3. How much electricity do you use in a year, kWh?
- 4. What is your facility's primary thermal load (i.e., DHW, steam/HW space heating, process steam,
- 5. What is your average thermal demand? (MMBtu/hr), or
- 6. How much fuel (gas/oil/etc) do you use in a year? (MMBtu/yr, Therms/yr, etc.)
- 7. What is your current fuel price? (\$/MMBtu)
- 8. How much do you pay for fuel annually? (Dollars/yr)
- 9. What are the CHP Fuel Costs? (\$/MMBtu)
- 10. What is your average electricity price? (\$/kWh)
- 11. How much do you pay for electricity annually? (Dollars/yr)
- 12. What is the efficiency of your existing boiler(s)/thermal equipment? (decimal)
- 13. What is the efficiency of your existing chillers? (kWh/ton)

CHP System

Net CHP Power, kW	1
CHP Electric Efficiency, % (HHV)	30
CHP Thermal Output, Btu/kWh	3
CHP Thermal Output, MMBtu/hr	
CHP Power to Heat Ratio CHP Availability, %	
Incremental O&M Costs, \$/kWh	\$0
Thermal Utilization, %	
Total Installed Costs, \$/kW	\$2

CHP System Specs CHP system specs CHP system specs CHP system specs Calculated based on CHP power output and thermal output 90 to 98% CHP system specs Amount of available thermal captured and used - typically 80 to 100%

CHP system specs

RGE HW Boiler

RGE Chiller

day/week, hours/day	8,760			
	1,084			
	9,369,859			
cooling, etc.)	Space Heating			
	6.01			
	51,922			
	\$7.850			
	\$405,770			
	\$7.850			
	\$0.077			
	\$712,509			
	0.90			
	0.60			

		Based on Recip Engines			sed on Ga	s Turbine	S
0.34	2.64	3.85	10.67	24.47	52.62	76.42	141.33
50	600	1,000	3,300	5,000	10,000	20,000	45,000
Α	В	С	D	E	F	G	н
12,637	9 <i>,</i> 896	<mark>9,264</mark>	8,454	11,807	12,482	10,265	9,488
27.0%	34.5%	<mark>36.8%</mark>	40.4%	28.9%	27.3%	33.2%	36.0%
6,700	4,392	<mark>3,854</mark>	3,233	4,893	5,262	3,821	3,141
0.34	2.64	<mark>3.85</mark>	10.67	24.47	52.62	76.42	141.33
80%	85%	<mark>85%</mark>	85%	100%	100%	100%	100%
50%	50%	<mark>50%</mark>	50%	90%	90%	90%	90%
80%		<mark>78%</mark>	79%	70%	69%	70%	69%
\$0.0240	\$0.0210	<mark>\$0.0190</mark>	\$0.0126	\$0.0123	\$0.0120	\$0.0093	\$0.0092
\$2,900	\$2,737	\$2,335	\$1,917	\$2,080	\$1,976	\$1,518	\$1,248
,	50 A 12,637 27.0% 6,700 0.34 80% 50% 80% \$0.0240	50 600 A B 12,637 9,896 27.0% 34.5% 6,700 4,392 0.34 2.64 80% 85% 50% 50% 80% \$0.0210	50 600 1,000 A B C 12,637 9,896 9,264 27.0% 34.5% 36.8% 6,700 4,392 3,854 0.34 2.64 3.85 80% 85% 85% 50% 50% 50% \$0.0240 \$0.0210 \$0.0190	50 600 1,000 3,300 A B C D 12,637 9,896 9,264 8,454 27.0% 34.5% 36.8% 40.4% 6,700 4,392 3,854 3,233 0.34 2.64 3.85 10.67 80% 85% 85% 50% 50% 50% 50% 50% 80% 78% 79% \$0.0240 \$0.0210 \$0.0190 \$0.0126	50 600 1,000 3,300 5,000 A B C D E 12,637 9,896 9,264 8,454 11,807 27.0% 34.5% 36.8% 40.4% 28.9% 6,700 4,392 3,854 3,233 4,893 0.34 2.64 3.85 10.67 24.47 80% 85% 85% 100% 50% 50% 50% 90% 80% 78% 79% 70% \$0.0240 \$0.0210 \$0.0190 \$0.0126 \$0.0123	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	50 600 1,000 3,300 5,000 10,000 20,000 A B C D E F G 12,637 9,896 9,264 8,454 11,807 12,482 10,265 27.0% 34.5% 36.8% 40.4% 28.9% 27.3% 33.2% 6,700 4,392 3,854 3,233 4,893 5,262 3,821 0.34 2.64 3.85 10.67 24.47 52.62 76.42 80% 85% 85% 100% 100% 100% 50% 50% 50% 90% 90% 90% 80% 78% 79% 70% 69% 70% \$0.0240 \$0.0210 \$0.0190 \$0.0126 \$0.0123 \$0.0120 \$0.0093

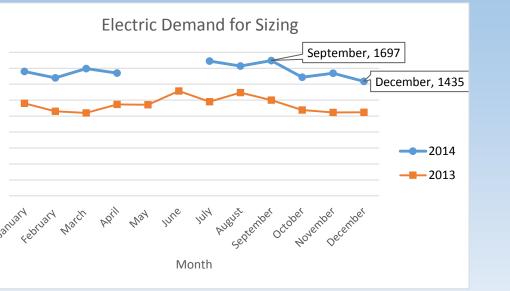
GE Jenbacher Reciprocating Engine

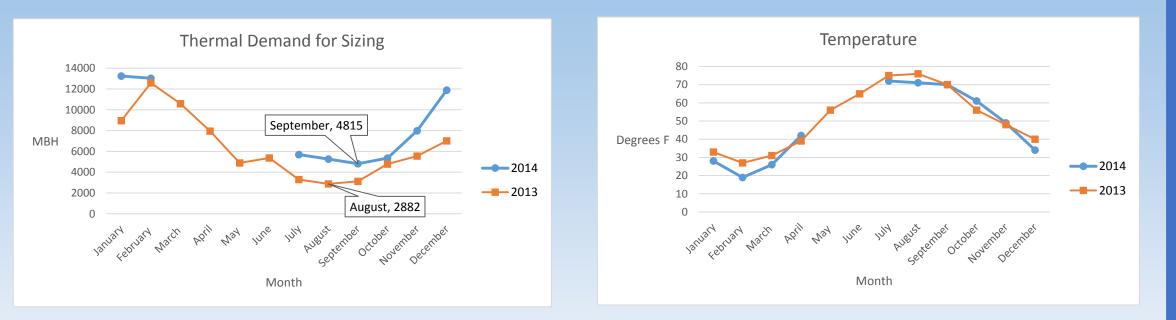


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		FY 14
	\$/kwh	\$0.069
Yearly Average	\$/MMBTU	\$4.51
	Spark Gap	\$15.69
	kW	1565
	MBH	8418
	λD	1.58
	Temperature	0

System Sizing





			Cooling	g Months			
		June	July	August	September		
	total kW		1,689	1,627	1,697	avg. (non-cooling) kW	1,435
2014	cooling power (kW)		254	193	262	avg. (cooling) kW	236
	cooling load (MBH)		5087	3858	5240	Avg. Cooling MBH	4,728
	cooling load (Ton)		424	322	437	Avg. Cooling Tons	394

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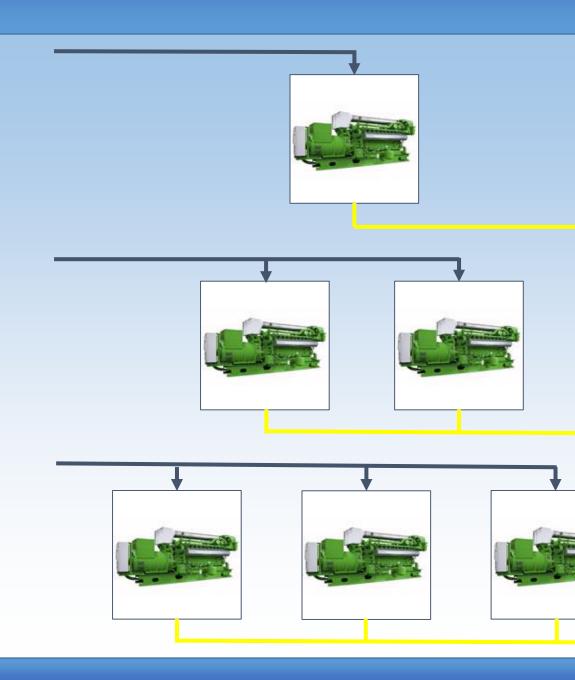




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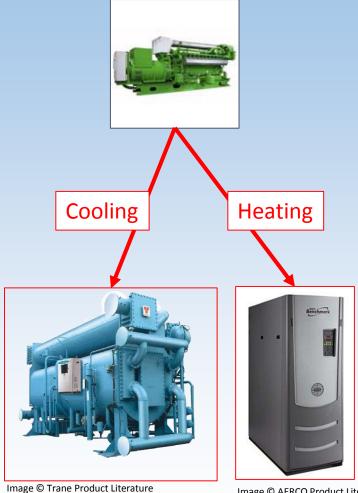
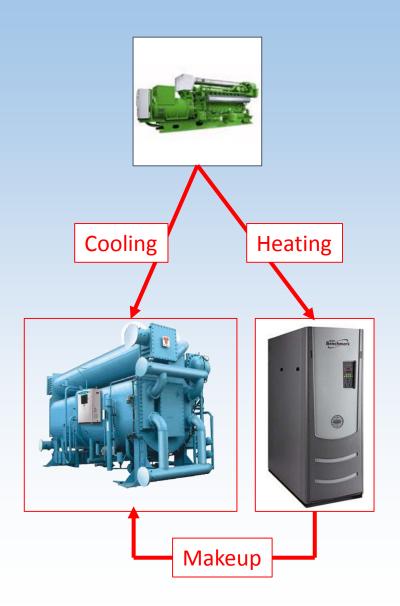


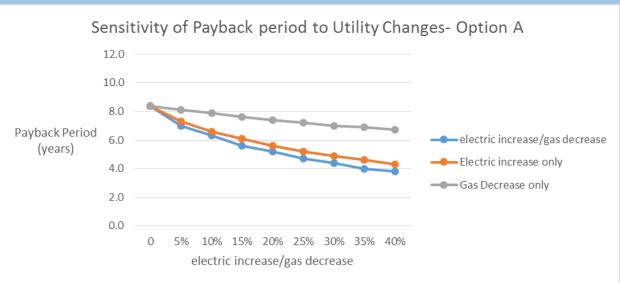
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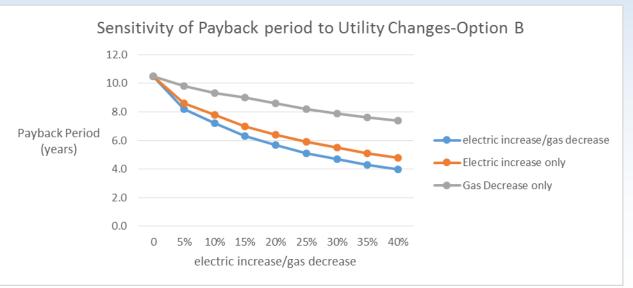


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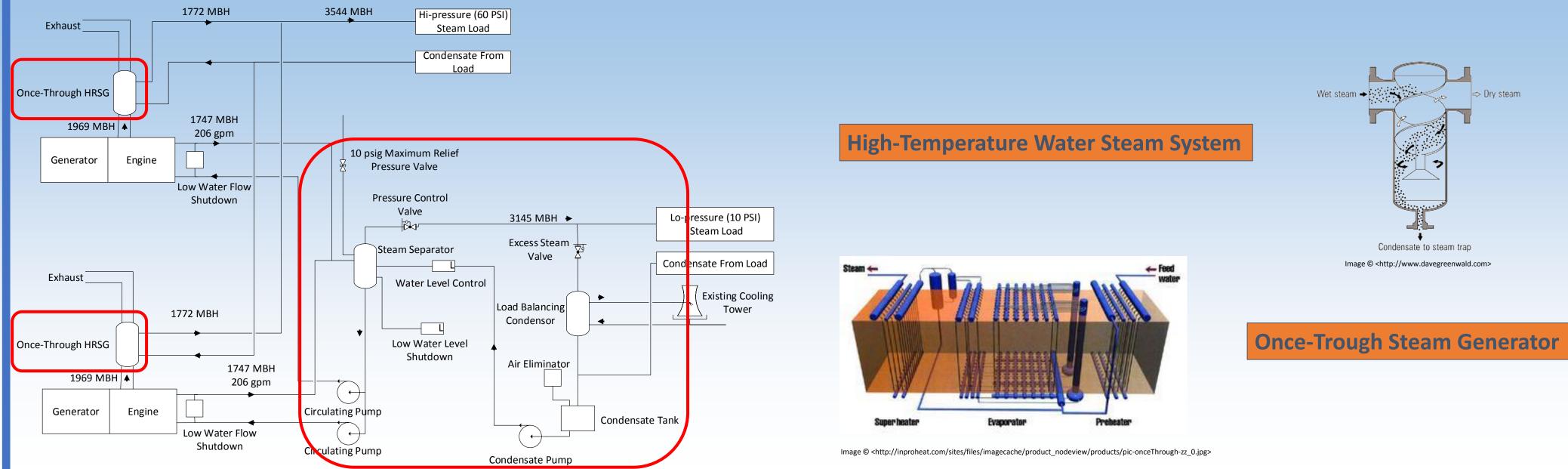
				Emissions	
Configuration	Equipment Setup	Payback Period	Vehicles	Houses	
А	1 GE Jenbacher J420 with process steam load	8.4	2,201	1,439	
В	2 GE Jenbacher J316 with process steam load	10.5	2,630	1,720	
С	3 GE Jenbacher J312 with process steam load	14.4	2,945	1,926	
D	1 GE Jenbacher J420 with trigeneration, absorption cooling sized to thermal output	11.1	2,076	1,358	
E	2 GE Jenbacher J316 with trigeneration, absorption cooling sized to thermal output	11.4	2,461	1,610	
F	3 GE Jenbacher J312 with trigeneration, absorption cooling sized to thermal output	14.5	2,756	1,802	
G	1 GE Jenbacher J420 with trigeneration, full load absorption cooling with boiler makeup	11.4	2,076	1,358	
н	2 GE Jenbacher J316 with trigeneration, full load absorption cooling with boiler makeup	11.5	2,461	1,610	
I	3 GE Jenbacher J312 with trigeneration, full load absorption cooling with boiler makeup	14.5	2,756	1,802	

Plant Configuration Results

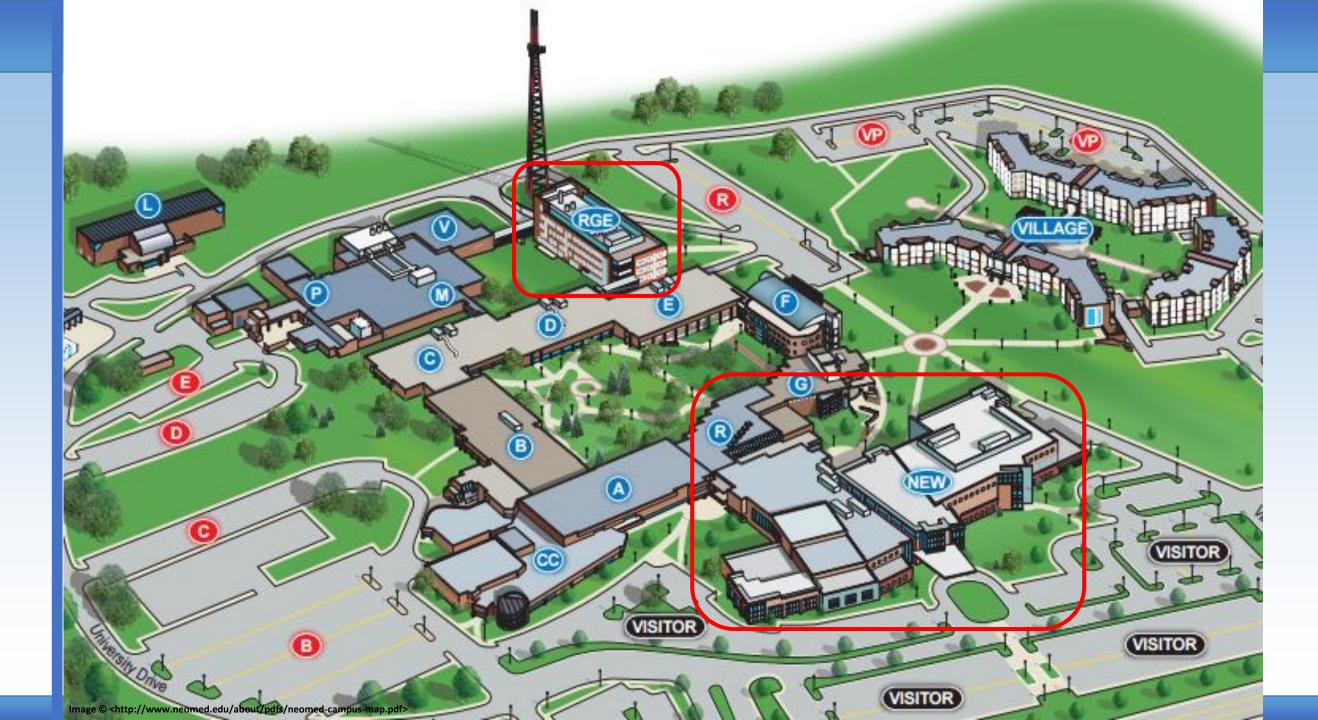




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Further Expansion

Generator Sizing Accommodates Expansion

- Fit out of 4th Floor
- AHU Humidifiers

Locate Additional Plant Capacity in NEW Building

- Lap Pool
- Hydrotherapy Pool

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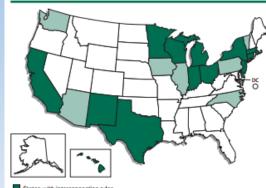
Ohio has very "DG-Friendly" Policies

Disconnect Switch at discretion of Utility

No Generation System Size Limit for Interconnection

Net Metering mandated for all IOU's; No Generation System Size Limit

Figure 5.4.1: States with DG Interconnection



States with proposed interconnection rul

- New Jersey also has interconnection standards for net metered renewable DG ≤ 2 MW.
- New Hampshire has interconnection standards for net metered renewable DG ≤ 25 kW.

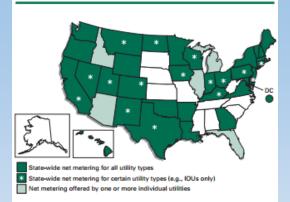
Maximum System Size for a State Interconnection Standard						
CA	None	NH	25 kW			
СТ	25 MW	NJ	2 MW			
DE	1 MW	NM	10 kW			
HI	None	OH	None			
MA	None	NY	2 MW			
MI	None	TX	10 MW			
MN	10 MW	WI	15 MW			
NCa	100 kW					

a System size is limited to 20 kW for residential customers.

Source: Navigant 2005.

Image © EPA Clean Energy-Environment Guide to Action

Figure 5.4.2: States with Net Metering Rules



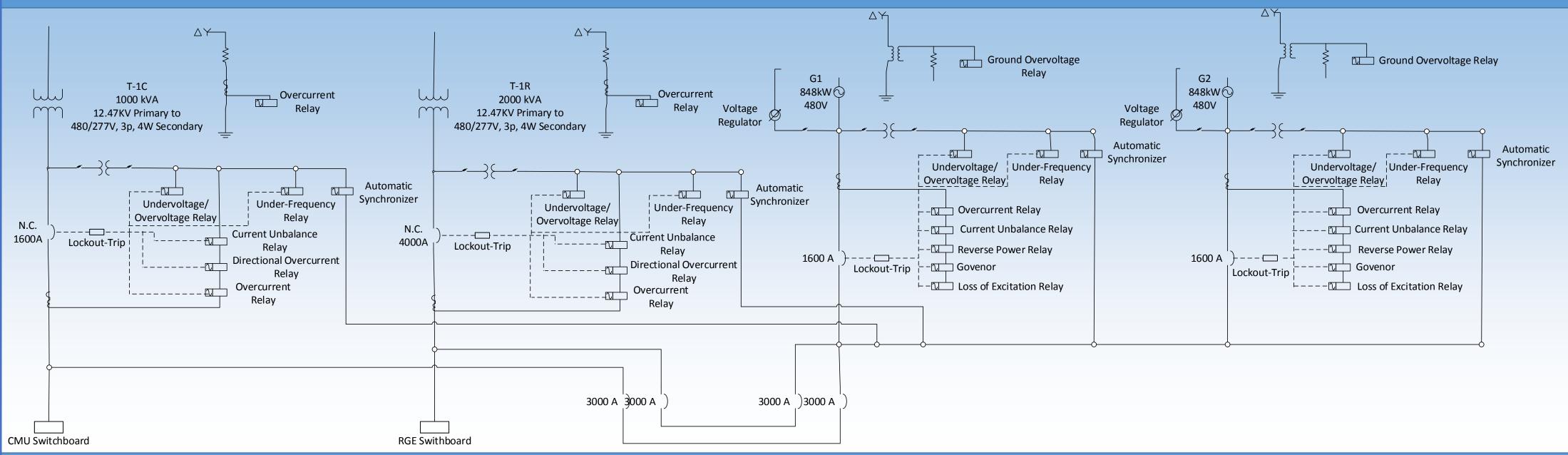
Net Metering System Size Limit (kW)

(in some cases limits are different for residential and commercial as shown)					
AR	25/100	MN	40		
AZ	10	MT	50		
CA	1,000	ND	100		
CO	Under development	NH	25		
СТ	100	NJ	2,000		
DC	100/25	NM	10		
DE	Varies	NV	30		
FL	Varies	NY	10/400		
GA	10/100	OH	No limit		
HI	50	OK	100		
IA	Varies	OR	25		
ID	25/100	PA	Varies		
IL	40	RI	25		
IN	10	TX	50		
KY	15	UT	25		
LA	25/100	VA	10/500		
MA	60	VT	15/150		
MD	80	WA	25		
ME	100	WI	20		
MI	Varies	WY	25		

Source: IREC 2005.

Image © EPA Clean Energy-Environment Guide to Actic

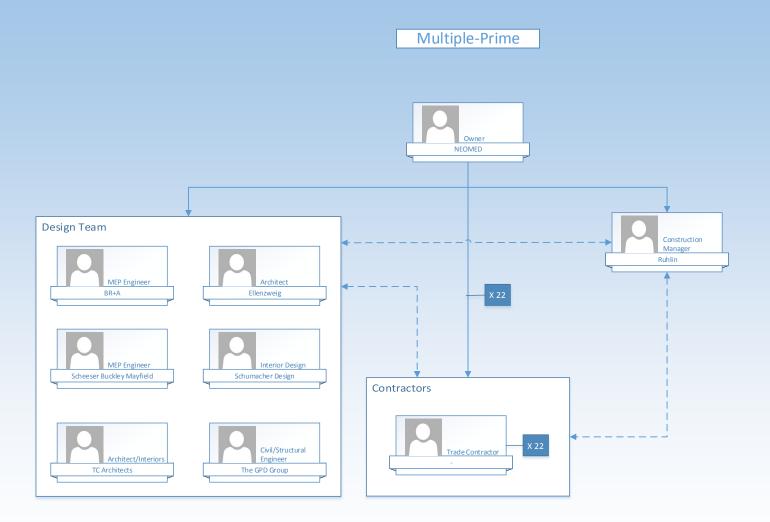
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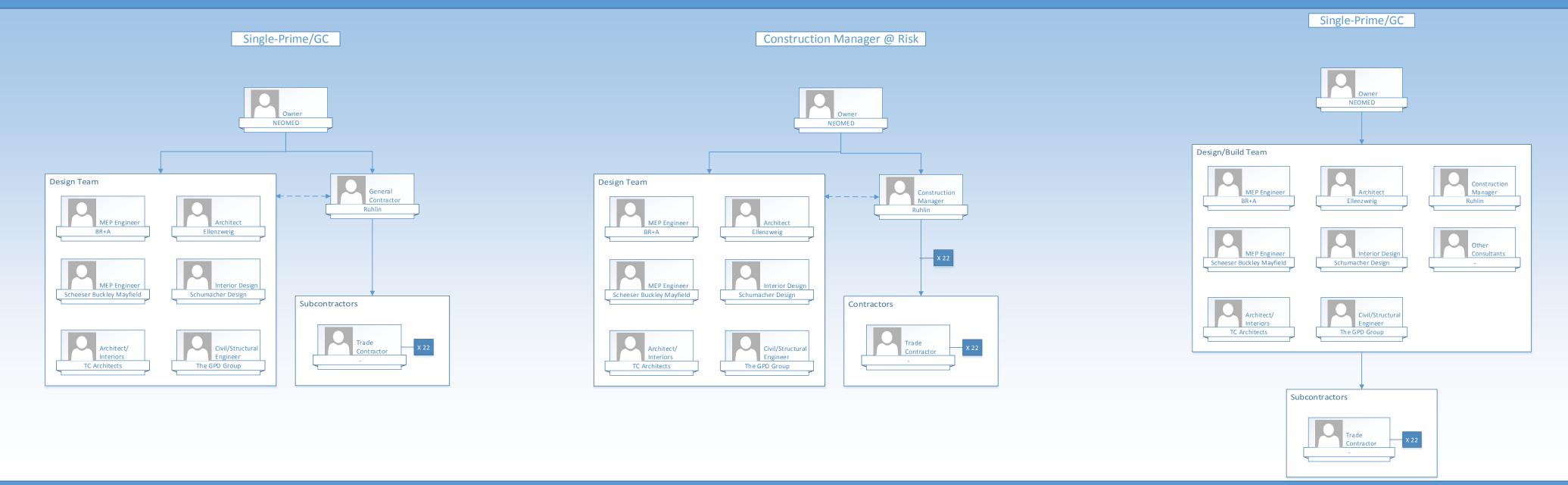
Generation and Utility Parallel Operation Schematic

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Project Delivery Methods

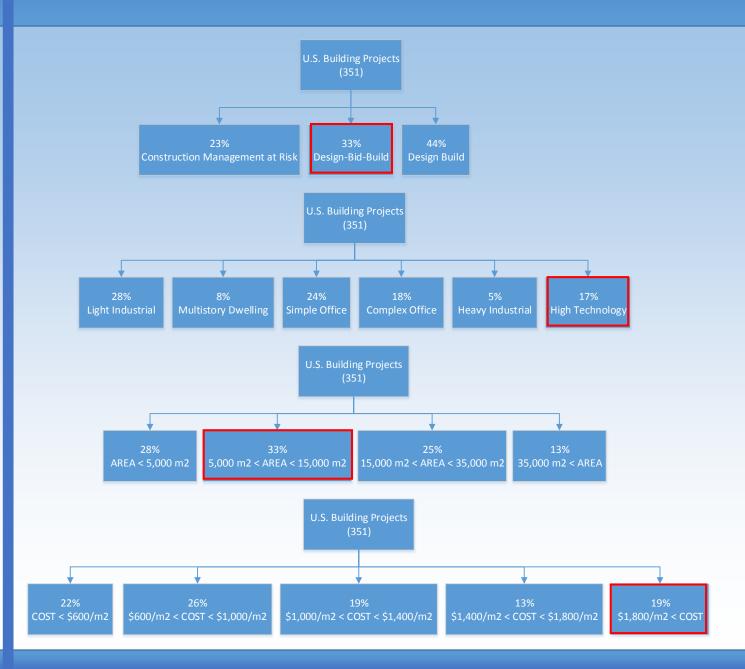


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Metric Facility Type	Unit Cost	Cost Growth	Schedule	Construction Speed	Delivery Speed	Intensity	Turnover Quality	System Quality	Equipment Quality
Light industrial	DB, CMR < DBB	0	CMR < DB, DBB	DB, CMR > DBB	DB, CMR > DBB	0	0	DB > DBB	0
Multi-story dwelling	0	0	0	0	0	DB > DBB	0	0	0
Simple office	0	0	CMR < DBB	0	CMR > DBB	DB > CMR, DBB	CMR > DB, DBB	0	0
Complex office	0	0	DB < DBB	0	0	DB > DBB	DB > CMR, DBB	0	DB > CMR
Heavy manufacturing	0	0	0	0	0	0	0	0	0
High technology	0	DB < DBB	-0-	0	0	DB > CMR	DB, CMR > DBB	D8 > D88	0

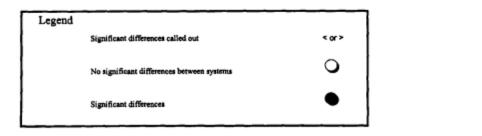


FIG. 2. Matrix of Significance by Facility Type and Owner Type Unadjusted for Other Explanatory Variables

Image © Journal of Construction Engineering and Management Nov/Dec 1998



- 50% DBB more than 4% late
- CMR,DB Quality > DBB Quality



- DB < CMR DBB
- Delivery Method significant influence on construction speed, some influence on total delivery speed
- Delivery Method single biggest influence on schedule growth
- Project Delivery Method biggest influence on every metric overall, matched only by Facility Type

Univariate Results

• 50% CMR and DB delivered on-time or early

Multivariate Results

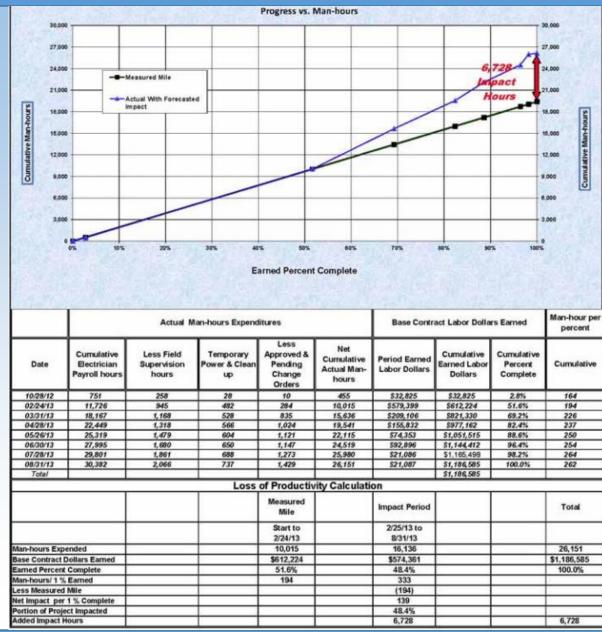
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Activity Activity	Orig Rem % Early Early	D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J					RS07-8 FOR RUHLIN / OWNER / OFCC REVIEW		1	NE	EOMED	RS07-8 Printed 27-May-13 09:08
ID Description												
CR-760 ROOF - Install Main & Penthouse Roots [RGE]	20 20 0 06NOV12 05DEC12	ROOF - Install Main & Penthouse Roofs (RGE)							Revis	ed Baseline for J	July 15, 2013 Owner Move-In	
CR-530 GT - Install Wood Blocking in Walls (B-4) [RGE]	20 20 0 13NOV12 12DEC12	GT - Install Wood Blocking In Walls (B-4) [RGE]					Activity ID Task Description	Orio Rem 5	tart Finish T	lotal	2013	
CR-552 ALL - Building Dry-In / Temp Enclosure [RGE]	0 0 0 05DEC12	ALL - Building Dry-In / Temp Enclosure [RGE]						Orig Rem 5 Dur Dur	F	Float May	June July Augus 19 26 02 09 16 23 30 07 14 21 28 04 11	A September October hb
CR-570 GT - Hang & Finish Drywall (1-4) [RGE]	65 65 0 06DEC12 12MAR13	GT - Hang & Finish Drywall (1-4) (RGE)					Milestones	101 101 20	May-13 10-Del-13	-30		
CR-580 GLASS - Install Interior Glass (8-4) [RGE]	20 20 0 06DEC12 08JAN13	GLASS - Install Interior Glass (B-4) [RGE]					No. of Concession, Name	101 101 25	Nep-13 10-Oct-13	-38		
CR-780 GLASS - Install Exterior Glazing (RGE)	40 40 0 06DEC12 05FEB13	GLASS - Install Exterior Glazing [RGE]						101 101 20	May-13 10-Oct-13	-0		
CR-380 HVAC - Install HVAC Duct & Pipe R-I (R&P) [RGE]	25 25 0 06DEC12 15JAN13	HVAC - Install HVAC Duct & Pipe R-I (R&P) [RGE]					M-510 CMU Electrical Upgrades Construction Complete	0 0	20-May-13*	31 0	CMJ Electrical Upgrades Construction Complete	
CR-554 ELECT - Permanent Electric Power Available (RGE)	0 0 0 19DEC12	PELECT - Permanent Electric Power Available (RGE)					16-31 Electrical Loop Relocation #2 Complete 16-50 CAU Dehesion Suite Construction Complete	• •	31-May-13*	-34	Electrical Loop Relaxation #2 Complete	
CR-556 ELEV - Install Elevators (RGE)	60 60 0 20DEC12 19MAR13	ELEV - Install Elevators [RGE]					14410 Chill Behavior Suite Construction Complete 14-210 Chill New Mech Building Construction Complete	0 0	03-Jun-13*	14	O/U Behavior Suite Construction Complete O/U Behavior Suite Construction Complete O/U New Mech Building Construction Complete	
CR-382 PLUMB - Install Plumbing R-I (R&P) (RGE)	10 10 0 20DEC12 08JAN13	PLUMB - Install Plumbing R-I (R&P) [RGE]					M-310 CAU MEP & Boller House Construction Complete	0 0	19-Jun-13*	•	CIAU MEP & Color House Construction Complete	
CR-384 ELECT - Install Electrical R-I (R&P) [RGE]	21 21 0 02JAN13 30JAN13	ELECT - Install Electrical R-I (R&P) [RGE]					N-32 Campus - Cooling Tower Replacement Complete	0 0	21-Jun-13*	-15	Cartpus - Coding Tower Replacement Complete	
CR-590 PAINT - Paint Walls, Doors, etc. [8-4) [RGE]	30 30 0 09JAN13 19FEB13	PAINT - Paint Walls, Doors, etc. [8-4] [RGE]					M-410 CMU Building Addi ion Construction Complete For Owner Mare	0 0	03-34-13°	2	CAU Building Addition Construction Demphete For Owner M	Ann I
	and the second se	ISPRINK - Install Sprinkler R-4 (R&P) [RGE]					M-720 Sitewark Complete M-710 RGE Building Construction Complete (7/15/13)	0 0	12-34-13*	1	Silveorit Congrists	
CR-386 SPRINK - Install Sprinkler R-I (R&P) [RGE]	5 5 0 16JAN13 22JAN13				Actual Substantial		M-79 Hut balance Complete (1715/15) M-29 Landesping Complete	0 0	10-08-13*	40	RGE Building Cananuction Campiete (7/15/1	Landaciping Compiles
CR-600 GT- Install Ceiling Grid (B-4) [RGE]	30 30 0 18JAN13 28FEB13	GT- Install Colling Grid (B-4) (RGE)					Life Safety	23 23 25		25		
CR-650 GT - Install Cabinets & Millwork (B-4) [RGE]	20 20 0 18JAN13 14FEB13	GT - Install Cabinets & Millwork [B-4] [RGE]		Bid Schedule	Completion	Days Delayed	LS-900 Life Safety Pre Teating	2 2 25		2	Life Safety Pre Testing	
CR-610 ELECT - Install Light Fitures (8-4) [RGE]	30 30 0 15FEB13 28MAR13	ELECT - Install Light Fitures (B-4) [RGE]					LS-1025 Life Safety Final Testing (SCHEDULED ON JUNE 27-13)	1 1 27		2	Life Safety Final Testing (SCHEDULED ON/LINE 27-13)	
CR-690 SIGN - Install Interior Signage (B-4) [RGE]	10 10 0 20FEB13 05MAR13	SIGN - Install Interior Signage (B-4) [RGE]					LS-1026 Wat on Final Repedor	8 8 28		2	Wat on Final Impediar	
CR-620 HVAC - Install HVAC Diffusers [8-4) [RGE]	25 25 0 01MAR13 04APR13	VAC - Install HVAC Diffusors (8-4) (RGE)	Chill	E/40/0040	7/04/0040	70	LS-1027 TOO STRUCTURAL INSPECTION (SCHEDULED ON JULY 11-13)	1 1 1		2	TOD STRUCTURAL INSPECTION (SCHEDULED O	
CR-630 SPRINK - Install Sprinkler Heads [B-4) [RGE]	10 10 0 01MAR13 14MAR13	SPRINK - Install Sprinkler Heads (8-4) [RGE]	CMU	5/13/2013	7/31/2013	79	CD420 NEOKED - Mow Staff to New RGE Bidg (JULY 15-13)	and the second sec	A4-13 26-A4-13 m-13.4 10-0td-13	25	NECHTED - Move Staff to Ne	a RGE Bidg (JJJY 15-13)
CR-640 GT - Install Ceiling Pads (B-4) [RGE]	10 10 0 01MAR13 14MAR13	GT - Install Ceiling Pads (B-4) [RGE]					Construction					
CR-660 FLOOR - Install Floor Coverings (B-4) [RGE]	45 45 0 08MAR13 09MAY13	FLOOR - Install Floor Coverings (B-4) [RGE]					New Research Graduate Education (RGE) Building		ID-13 A 10-0d-13	-7		
CR-566 ELEV - Test & Inspect Elevators (RGE)	5 5 0 20MAR13 26MAR13	ELEV - Test & inspect Elevators (RGE)	RGE	5/31/2013	7/31/2013	61	Owner-Related OWN-100 OWNER - Instalation of Security Devices (IRDE)		12-34-13 12-34-13	30	OWNER - Installation of Geounty Devices (RGE)	
CR-670 PLUMB - Install Plumbing Fixtures (B-4) (RGE)	15 15 0 22MAR13 11APR13	PLUMB - Install Plumbing Fixtures (B-4) (RGE)	NOL	5/31/2013	1131/2013	01	OWN-200 OWNER - Initial Furniture / Furnishings (RGE)		Am-13" 12-Jul-13	35	OWNER - Initial Furnitions (FIGE)	
CR-680 GT - Install Doors & Hardware (B-4) [RGE]	10 10 0 29MAR13 11APR13	GT - Install Doors & Hardware [B-4) [RGE]					Brick	70 19 064	ant3.A Hubert3	20		
CR-910 PUNCH - Start-up, Balance, Punchilst, Etc. [RGE]	15 15 0 10MAY13 31MAY13	UNCH - Start-up, Balance, Punchlist, Etc. (RGE)					OR-745 MASON - Install Ext Masonry Wale & Beck [RGE]	50 7 06-1		1 E	MASON - Install Est Masonry Walls & Brick (RGE)	
Comparative Medical Unit (CMU) Building Ac		- chorr of an early an early a manage set from t					CR-700 SIGN - Install Exterior Burninated Sign (RGE)		An-13* 14-Jan-13 Ian-13 A 17-Jan-13	20	SIGN - Install Eductor Runningtod Sign (MCE)	
Animal Area	aaruon						North Curtainwall Ot-822 GLASS - Sixk Curtainwal Detailing (RGE)	18 4 284		13	GLASS Site Curtained Detailing (RGE)	
CC-AA-100 GT - Start Construction Animal Area [CMU-AA]	0 0 0 13FEB12	GT - Start Construction Animal Area [CMU-AA]					CR-781 GLASS - Extentor North Custainwall Glass (FIGE)	10 10 20-			GLASS - Extentor North Curtainwell Glass (PGE)	
CC-AA-110 GT - Install Temp Walls & Closures (CMU-AA)	5 5 0 13FEB12 17FEB12	IGT - Install Temp Walls & Closures (CMU-AA)					CR-782 GLASS - Exterior North Custainwell Detail (MGE)	10 10 04		33	GLASS - Exterior North Curtainwall Datad [PIGE]	
CC-AA-180 SITE - Complete Site Utility Relocation [CMU-AA]		SITE - Complete Site Utility Relocation (CMU-AA)					Final Site Work	106 101 134		-42		
		ISTE - Prepare Building Pad (CMU-AA)					C5-340 SITE - Pour Concelle Passments C5-329 SITE - Rough Grading After Bidg Ext Complete	5 5 30			SITE - four Concele Pavements SITE - Rough Grading After Bidg Ent Complete SITE - Rough Grading After Bidg Ent Complete	
CC-AA-190 SITE - Prepare Building Pad [CMU-AA]	5 5 0 16FEB12 22FEB12						CS-310 SITE - Install 204 Paner Base ALL	1 1 06		16	SITE - Install 304 Percer Dame Still	
CC-AA-140 GT - Shore Exist Roof [CMU-AA]	5 5 0 20FEB12 24FEB12	IGT - Shore Exist Roof [CMU-AA]					CS-330 SITE - Pour Concrete Salevadia	6 6 06	Jun-13 13-Jun-13	1	SITE - Pour Concrete Sciencela	
CC-AA-120 GT - Demo Storage Room at Exist Dog Run [CMU-AA]		GT - Demo Storage Room at Exist Dog Run [CMU-AA]					CS-330 SITE - Install Aphalt Personanta	10 10 07		16	SITE - Instell Asphak Pavements	
CC-AA-130 GT - Demo Interior Area At New Cart Wash[CMU-AA]	5 5 0 20FEB12 24FEB12	GT - Demo Interior Area At New Cart Wash(CMU-AA)					CS-320 ELEC2 - Install Site Lighting - Bidg CS-321 ELEC2 - Install Site Lighting - Read	54 54 54 6 6 05		1	ELEC2 - Install Site Lighting - Bidg	
CC-AA-200 GT - F/R/P Concrete Foundation (Build) [CMU-AA]	15 15 0 23FEB12 14MAR12	GT - F/R/P Concrete Foundation (Build) [CMU-AA]					CS-321 ELEC2 - brain Sile Lighting - Road CS-400 SITE - Spread (FALL 2013)	10 10 03-		-62	ELEC2 - Inded Site Lighting - Read	Sife - Spread James (FALL 2013)
CC-AA-150 GT - Construct Temp Access to Dog Run [CMU-AA]	10 10 0 27FEB12 09MAR12	IGT - Construct Temp Access to Dog Run [CMU-AA]					CS-350 LAND - Install Plants / Trees and Mulch	5 5 17		-62		LAND -Install Plants / These and Muldh
CC-AA-160 GT - Remove Portion of Existing Roof [CMU-AA]	5 5 0 12MAR12 16MAR12	GT - Remove Portion of Existing Roof (CMU-AA)					CS-310 LAND - Install No-Mox Strips	3 3 24		-42		LASIC - Install No-Mow Strips
CC-AA-170 GT - Remove Existing Exterior CMU Wall [CMU-AA]	5 5 0 19MAR12 23MAR12	IGT - Bemove Existing Exterior CMU Wall [CMU-AA]					CS-370 LAND - Install Grass Param	3 3 27		42		LAND - Install Gram Param
CC-AA-210 GT - F/R/P Concrete Foundation (FWat) [CMU-AA]	10 10 0 26APR12 09MAY12	GT - F/R/P Concrete Foundation (FWall) [CMU-AA]					C5-380 LAND - Fine-Grade and Seed	7 7 00		42		LAND - Fine-Grade and Seed
CC-AA-230 GT - Prep Exist Walls for Steel Connect [CMU-AA]	10 10 0 28APR12 09MAY12	GT - Prep Exist Walls for Steel Connect (CMU-AA)					Basement Ch440 (MWCT "REVISED") WLS/CLG - Hang & Freeh Dywel (8) (HGE)	117 37 26-		2	(MINCT "REVISED") WLSID.G - Hung & Finish Grywell (8) (RGE)	
CC-AA-240 MASON - Install CMU Firewall (Exist&New)(CMU-AA)	15 15 0 26APR12 16MAY12	MASON - Install CMU Firewall (Exist&New)(CMU-AA)					CR-630 GT - Install Doom(CMP) & Handware (B) (RGE)	5 2 074			GT - halal Door(CAP) & Hardwaye (5) (RGE)	
CC-AA-270 MASON - Install Int Bearing CMU Wall [CMU-AA]	10 10 0 26APR12 00MAY12	MASON - Install int Bearing CMU Wall (CMU-AA)					CR-432 PLUMB - Set / Install PC Water System (8) [RGE]	6 1 254	lan-13 A 20-May-13	18	PLUMS - Se / Install PD Water System (8) (RGE)	
CC-AA-220 MASON - Install CMU Bearing CMU Wall [CMU-AA]		MASON - Install CMU Bearing Wall [Lock] [CMU-AA]					CR-440 MARC - Install T/C Devices, Equip (5) (RGE)	12 12 28		, E	HVAC - Install IVC Devices, Ecolop (6) (RGE)	
	5 5 0 10MAY12 16MAY12	MASON - Install CMU Bearing Wall (LOck) (CMU-AA)					CR-520 /RAT - Part Walk, Doon, etc. (8) (RGE) CR-556 ELEC2 - Install Electric Devices (8) (RGE)		Map-13 30-May-13 Map-13 12-Jun-13	2	PANT - Paint Walls, Coors, etc. (8) [PGE] ELECT - Install Electric Devices (8) [PGE]	
CC-AA-250 PLUMB - Install U/G Plumbing R-I [CMU-AA]	15 15 0 10MAY12 31MAY12							w w 30	ang-12 to date to	·		
CC-AA-280 STEEL - Set & Detail Steel & Roof Deck [CMU-AA]	15 15 0 17MAY12 07JUN12	STEEL - Set & Detail Steel & Roof Deck [CMU-AA]					Actual Work Critical Remaining Work				Page 1 of 8 TASK filters: NEO Not Complete , NEO Omit.	
CC-AA-260 ELECT - Install U/G Electrical R-I [CMU-AA]	10 10 0 24MAY12 07JUN12	ELECT - Install U/G Ejectrical R-I [CMU-AA]					Remaining Work Milestone					C Primavera Systems, Inc

Project Benefits

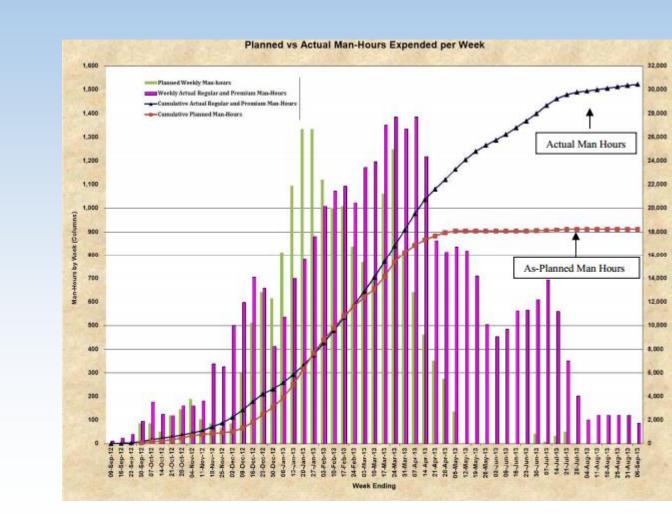
Schedule Slippage

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Project Benefits

Disputes



Added Labor Cost	\$384,580.00
Premium Time	\$17,770.00
Supervision	\$91,735.00
General Conditions	\$33,501.00
Home Office Support	\$69,615.00
Less: 2nd Shift Premium in Bid	(\$23,740.00)
Total	\$573,461.00

Original Contract Ame Executed Change C Agreed Upon Adjuste Amount Paid to Date Agreed Upon Contrac Pending Change Of Total Contract Balanc

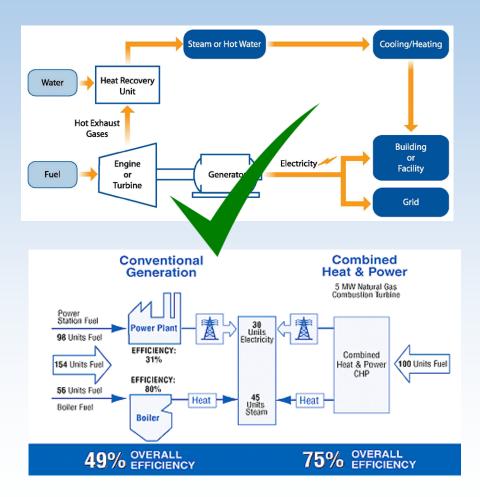
nount	\$3,486,140.00
Orders	\$301,699.53
ed Contract	\$3,787,839.53
e as of May 21, 2014	\$3,508,163.70
ct Balance	\$279,675.83
Orders	\$7,975.59
ce and Disputed Direct Costs	\$287,651.42

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Breadth 1: Power Interconnect & Black Start Capability



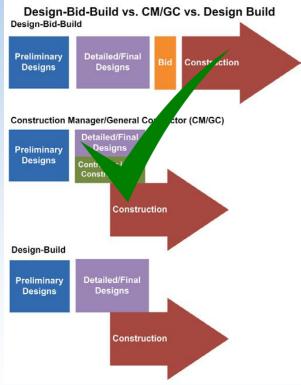
Depth: Cogeneration Plant Implementation



Breadth 2: Alternate Project Delivery System

Design-Build

Designs



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Acknowledgements

Chris Schoonover	Principal - Scheeser Buckley Mayfield, LLC
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Jim Rankin	Asst. Dir. of Campus Operations- Northeast Ohio Medical University
Jim Freihaut	Professor of Architectural Engineering – Penn State
Rob Leicht	Asst. Professor of Architectural Engineering – Penn State
Tim Warren	President - JDB Engineering, Inc.
Tom Leary	Executive VP/DOP - JDB Engineering, Inc.
Ari Tinkoff	Managing Director/Principal - BR+A Consulting Engineers
Scott Walthour	Managing Principal – Arium AE
Chris Elgin	Structural Engineer - GPD Group
Diet Mt. Dew	Carbonated Soft Drink – PepsiCo Inc.
Steam	Internet-based gaming platform – Valve Corporation



VALVE

