Project Development and Construction Case Studies

U.S. CHP Partnership 2009
Partnership Meeting
October 1, 2009

New York City, NY

Presentation Overview

- Burns & McDonnell CHP Project Development Approach
- Case Studies
  1. Thermal Energy Corporation Central Plant Expansion @ Texas Medical Center
  2. Gainesville Regional Utilities South Energy Center @ Shands Cancer Medical Center
- Questions & Answers

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Markets Best Served by CHP

- Hospitals/Research
- Data Center/Telecommunications
- Department of Defense
- Universities and Colleges
- Municipalities

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Facilities Best Suited for CHP

- CHP *"Best User" Profile* is:
  - Coincident electrical and thermal loads
  - 24 hour/day, 7 day/week, 365 day/year operation
  - Low seasonal variation in loads
  - High power reliability needs
- Hospitals fit the *"Best User" Profile* for Combined Heat and Power applications

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Hospital Drivers for CHP

- ***Cleaner Normal Power*** Local generation is anticipated to provide fewer sags and surges. Conversion from primary power to grid backup is measured in “cycles” rather than “seconds”.
- ***More Backup Power*** Both Grid backups supply 100% of the Hospital’s needs; not just its Life Safety requirements; imagine no chillers or HVAC in August.
- ***More Reliable Backup Power*** Probability of failure of the traditional Hospital “grid plus backup” is 67% according to Primen Perspective’s *RX for Health Care Power Failures*, DE-PP-24, 11/2003
- ***“Island” Power*** In the event of a grid failure due to natural, technical, or terrorist causes, this strategic community asset will remain in operation when we need it most.
- ***Reliable Normal Power*** When a hospital converts to fully digital Medical Records, RFID/Bar Code Scan Drug delivery, Computerized Physician Order Entry, etc., *health care delivery will stop if the “lights go out”.*

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CHP Project Methodology

Stakeholder Involvement Options

1. Self Fund Project
2. Outsource/Leaseback Project
3. Put the Project on the Shelf

Phase 1

Screening Analysis

2 Weeks

Report

Phase 2

Feasibility Study

8 Weeks

Report

+ NPV Economic Analysis

Phase 3

Preliminary Design

3 Months

Report

+ GMP for Final Design & Construction

+ Lease Agreement

Phase 4

Pre-Construction Services

Environmental Permits

Pre-Purchase

Final Design

Construction Phase Services

9 to 12 Months

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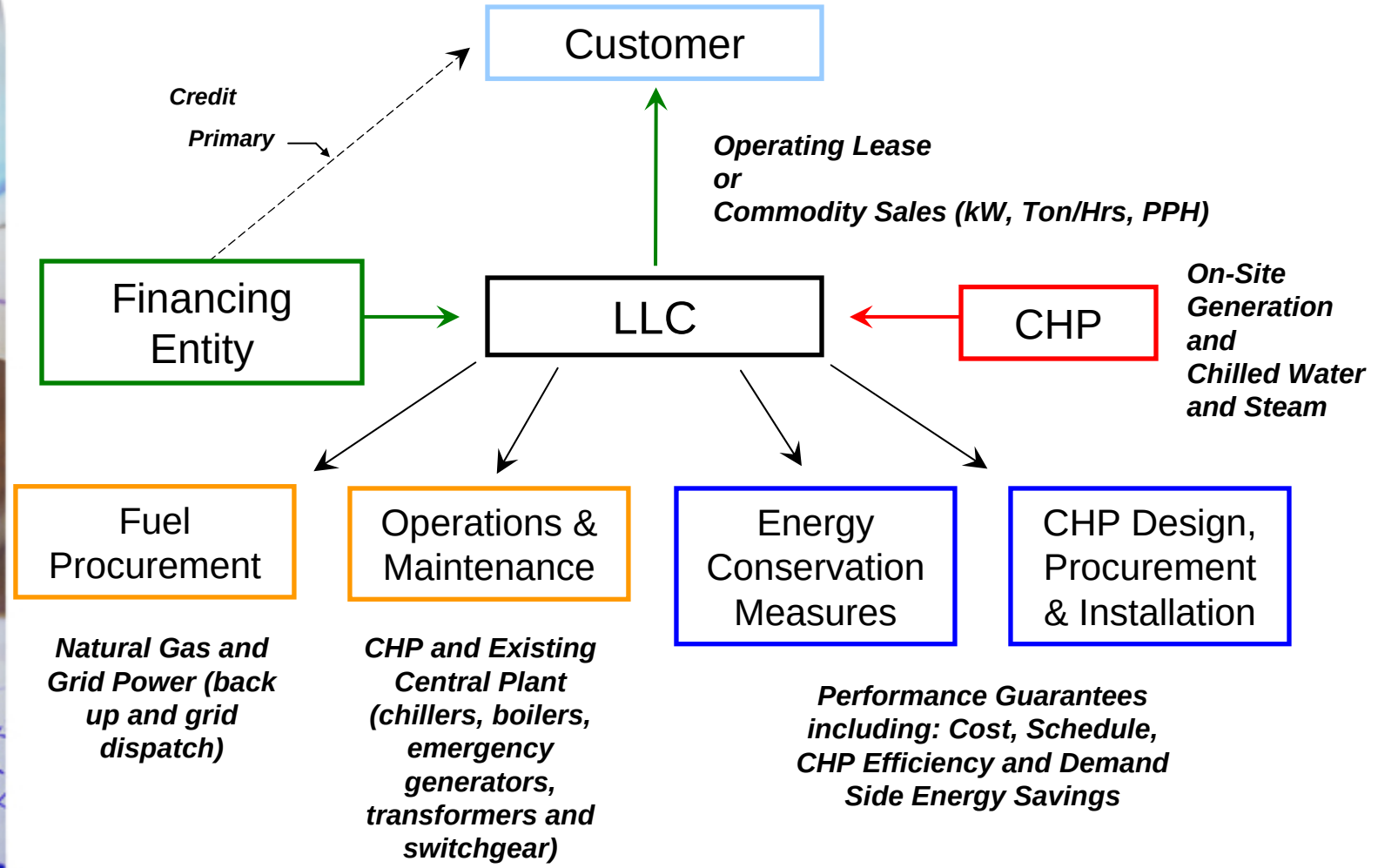
Outsourcing Business Structure



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District Energy Plant Expansion Case Study

Thermal Energy Corporation at Texas Medical Center

Thermal Energy Corporation (TECO)

- Provides thermal energy to 18 customer owned institutions in Texas Medical Center or - 16.6 million sq ft,
  - 4 2 buildings chilled water and 36 buildings steam
- Two thermal energy plants
  - 80,000 tons of chilled water
  - 762,000 pounds-per-hour of steam
  - Over 35 miles of distribution piping serving 15 million square foot of space; 75% of TMC

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Texas Medical Center (TMC)

- Improved security and reliability of utility infrastructure serving nation's most important Medical Centers
- On-site generation capacity will significantly reliability of the entire thermal system and support TMC during crisis situations
- Hurricane Ike, 85 mph winds, torrential rain and damage to the Houston area – TECO provided uninterrupted service to every TMC customer.

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TECO Plant Expansion

- Significantly change operations
  - Add capacity, improve efficiency, reduce emissions, strengthen overall systems reliability and emergency operation capacity
  - Integration of CHP to increase efficiency and reduce unit costs, while significantly reducing environments emissions

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TECO Before Plant Expansion

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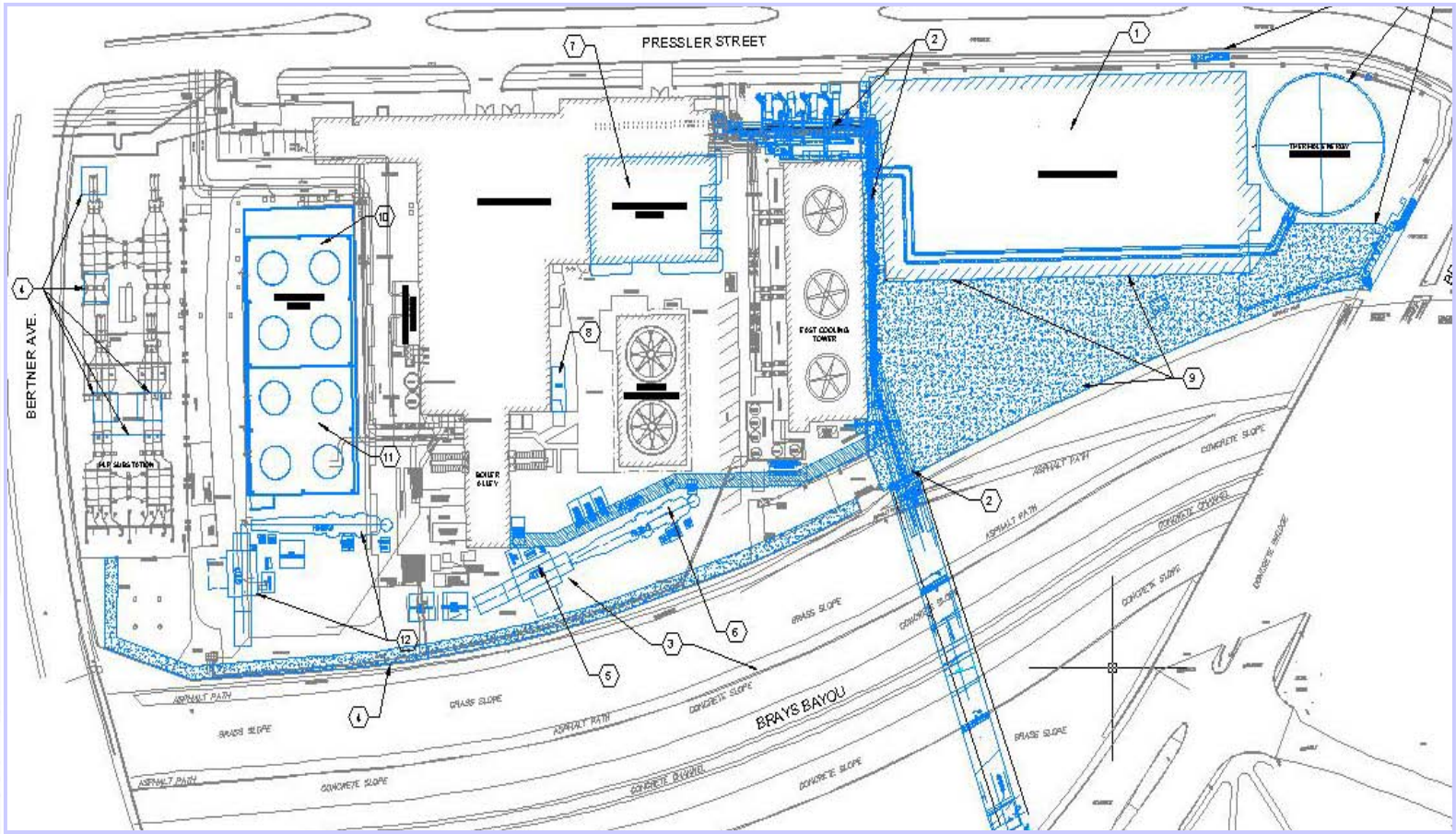
TECO Planned Plant Expansion



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Plant Major Enhancements

Current

- 80,000 tons chilled water
- 16 MW on-site generation
- 750,000 pph steam packaged boilers

Planned Growth

- 80,000 tons chilled water
- 152,000 ton hrs chilled water storage (16,000 tons)
- 100 MW CHP on-site generation
- 540,000 pph heat recovery steam generator

GOAL: *Thermally baseloaded plant that significantly improves efficiency, reliability and reduce environmental emissions.*

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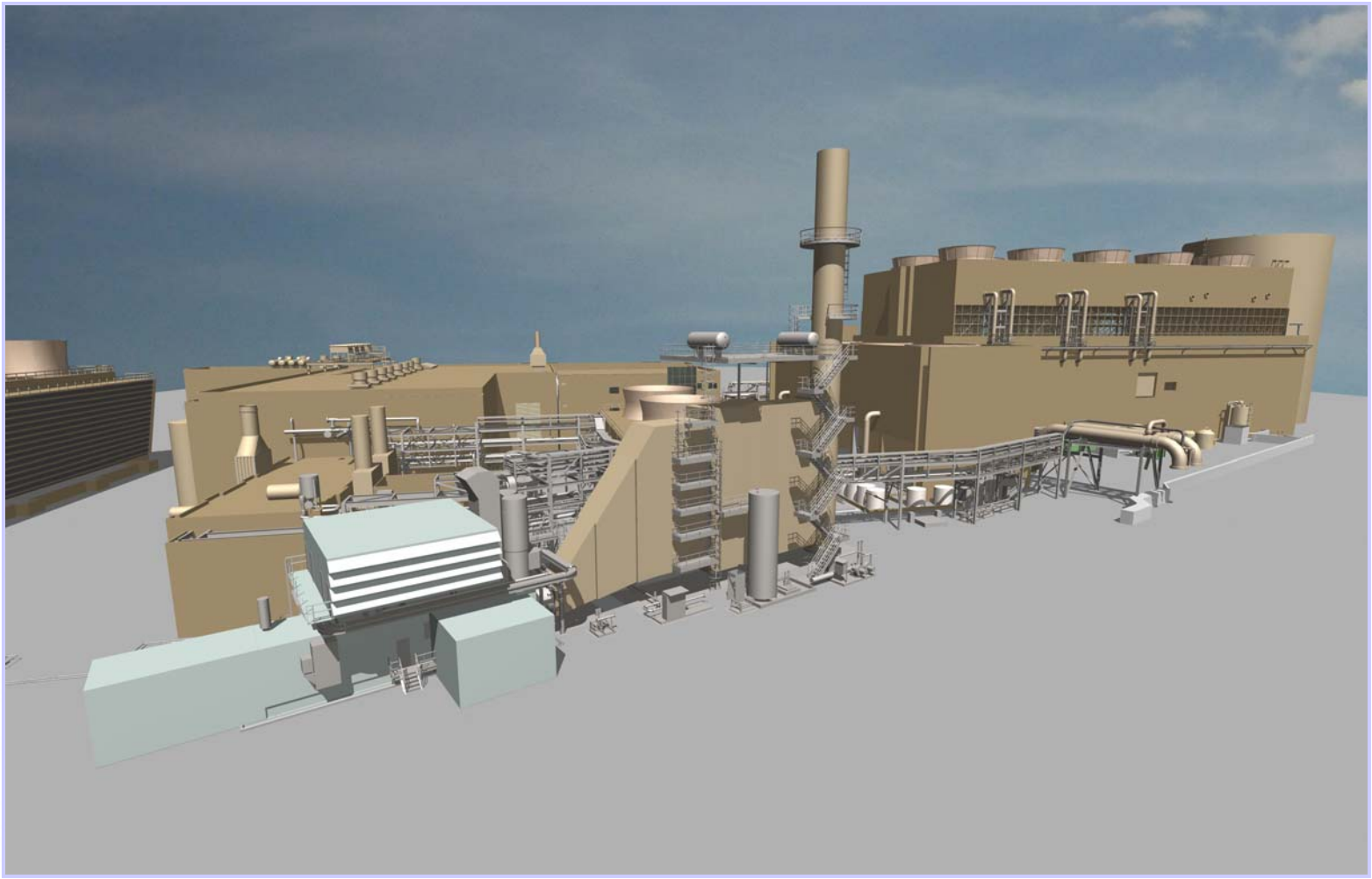
Plant Elevation Looking North



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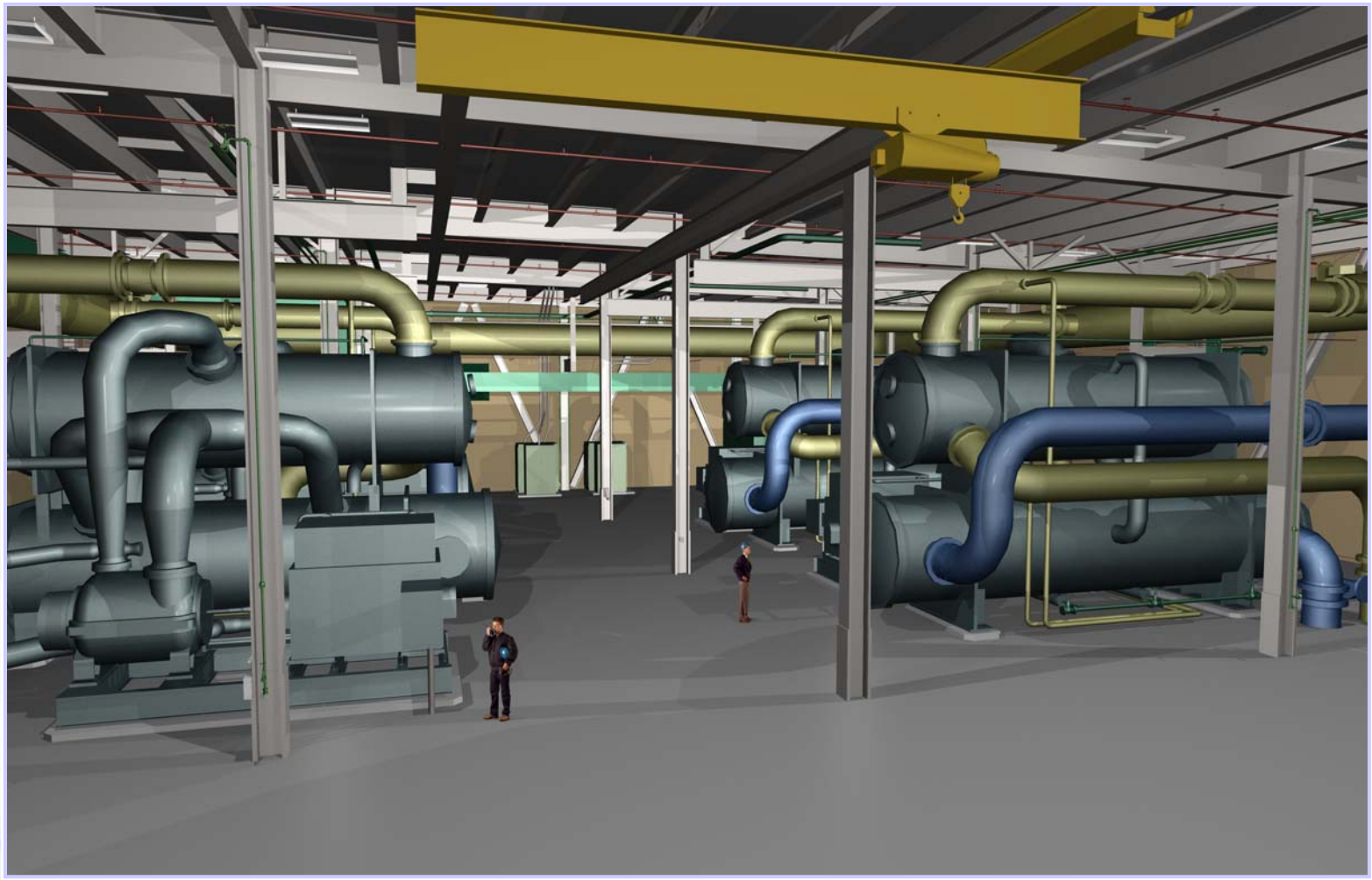
Plant Interior – Second Floor



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Energy Efficiency

- Chasing the BTU's
  - National average heat rate natural gas fired
    - Simple cycle combustion turbine = 11,664 Btu/kW
    - Combined cycle combustion turbine = 7,502 Btu/kW
  - ERCOT average central generation heat rate
    - 8,500 Btu/kW (low) to 10,700 Btu/kW (high)
  - TECO CHP System *(calculated)*
    - 5,000 Btu/kW (low) to 8,500 Btu/kW (high)

RESULT: *TECO CHP system will provide a competitive heat when compared to the National and ERCOT generation.*

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Efficiency Comparisons

- Existing TECO plant efficiency = ***40%***
  - 80,000 tons chilled water *(2 - 5,000 ton steam turbine drive)*
  - 16 MW on-site generation
  - 750,000 pph steam packaged boilers
- TECO plant efficiency after installation of CHP system = ***80%***
  - 80,000 tons chilled water
  - 152,000 ton hrs chilled water storage *(16,000 tons)*
  - 100 MW CHP on-site generation
  - 540,000 pph heat recovery steam generator

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Environmental Efficiency

CHP Results

The results generated by the CHP Emissions Calculator are intended for eductional and outreach purposes only; it is not designed for use in developing emission inventories or preparing air permit applications.

Annual Emissions Analysis					
	CHP System	Displaced Electricity Production	Displaced Thermal Production	Emissions/Fuel Reduction	Percent Reduction
NOx (tons/year)	8.06	132.14	228.02	352.11	98%
SO2 (tons/year)	0.80	481.94	1.34	482.48	100%
CO2 (tons/year)	161,042	199,709	266,788	305,455	65%
Carbon (metric tons/year)	39,819	49,380	65,966	75,527	65%
Fuel Consumption (MMBtu/year)	2,706,593	2,416,446	4,560,474	4,270,327	61%
Acres of Forest Equivalent				62,939	
Number of Cars Removed				50,452	

This CHP project will reduce emissions of Carbon Dioxide (CO2) by 305,455 tons per year

This is equal to 75,527 metric tons of carbon equivalent (MTCE) per year

This reduction is equal to removing the carbon that would be absorbed by 62,939 acres of forest

OR

This reduction is equal to removing the carbon emissions of 50,452 cars

Hybrid CHP Energy Center Case Study

Shands HealthCare Cancer Medical Center
At University of Florida

GRU More than Energy™

South Energy Center

recycling energy™ CHP It's time

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Shands UF Master Site Plan

- Planning vision & goals
  - Create a new “uniquely Shands at UF” identity for the new medical campus,
  - Create a flexible master plan that will adapt to UF&Shands’ long-term growth and the evolution of healthcare delivery, and
  - Create a campus that enhances the patient care experience and supports Shands’ mission as UF’s clinical partner.

Shands UF Master Site Plan

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Competitive Solicitation Process

- Multiple RFP's
- Strict qualification standards for performance
- Proposed business models
- Assigned energy values to even the field
- Interview for partners, not just vendors
- Understand governance
- Encourage creativity

Why Shands and GRU?

- Focus on core businesses
- Best practice to manage energy production and delivery
- Distributed generation/power redundancy
- Resource enhancement/customer growth
- Cost containment
- Community sustainability initiative

Shands UF Master Site Plan
Phasing and Evolution

- Phase 1
  - 192-bed Cancer Hospital
  - ED/Trauma
  - Supports Services
  - Surface Parking
  - Tunnel link to existing SUF
  - First phase of a long-term multiphase hospital relocation strategy

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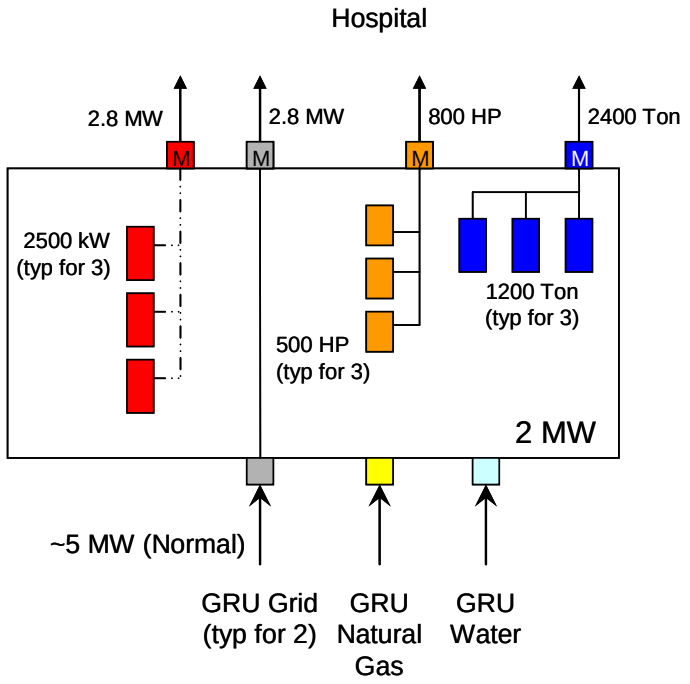
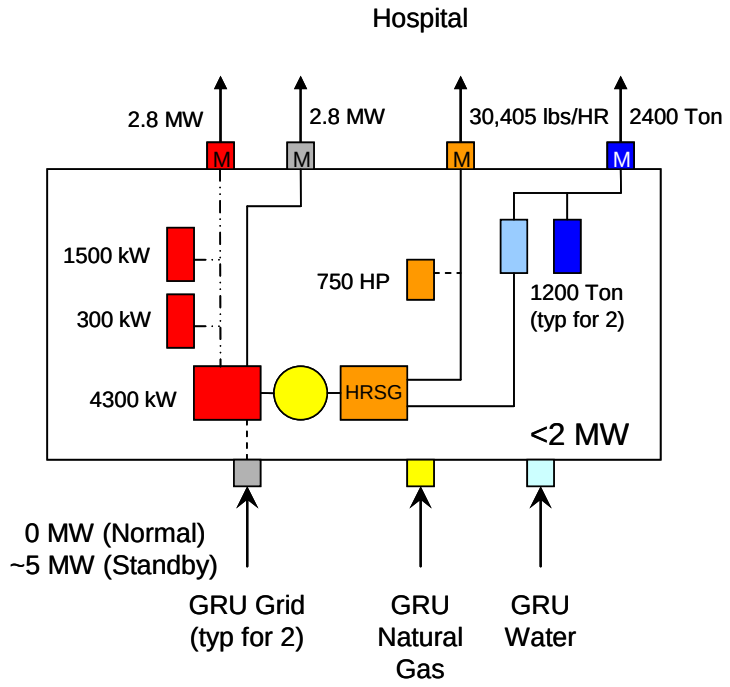
Creativity by Integrating CHP



Base Case CUP



CHP Alternative

Legend

- Steam Turbine Chiller (1200 Ton)
- Electrical Chiller (1200 Ton)
- Natural Gas Boiler
- Diesel Engine Generator
- Natural Gas CT Generator (nominal 4 MW)
- M — Hospital Meter

GRU More than Energy

Burns & McDonnell SINCE 1898

Shands Cancer Hospital
GRU Energy Partner Team
Proposed Central Plant Alternatives

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Shands Cancer Hospital

Business Case…

Hospital has selected GRU as it's Energy Partner to provide electricity, chilled water, steam and medical gases

GRU South Energy Center is expandable to meet planned future growth of Cancer Hospital

Will also serve Chilled Water to the larger planned "Urban Campus" as part of the South Campus Development

GRU provided bond financing to construct the Energy Center as part of a long-term energy agreement with the hospital. ***$30M Capital Savings accrued to the Hospital from not building its own Central Plant***.

SOUTH ENERGY CENTER a GRU business

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GRU South Energy Center

PROJECT FACTS

Owner: Gainesville Regional Utilities

EPC Contractor: Burns & McDonnell

Total Project Cost: $45,000,000

Project Completion: February 2009

Hospital Complete: November 2009

TECHNOLOGY HIGHLIGHTS

High Heat Rate Efficiency

Low Emissions

Grid Interconnect – Parallel & Island Mode

Integrated Controls System

LEED EA 1 Efficiency Credits for CHP

FEATURES

State-of-the-Art Technology

Modular & Packaged Components

Built-in Redundancy

Operational Flexibility

BENEFITS

Increased Efficiency

Improved Reliability

Reduced Emissions

Provides 100% of the Hospital's Electrical and Thermal Needs

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GRU South Energy Center

Benefits…

Enhanced quality of power assuring smooth, continuous operation of clinical devices

Two electrical feeds from different Substations in the surrounding power grid provide 200% electrical redundancy

Emergency Generators provided for black start of combustion turbine generator and as a third back-up for Life Safety Systems

As the Hospitals Energy Partner, GRU will finance, own, operate, and maintain the Energy Center reducing the hospital project capital costs

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GRU South Energy Center

Benefits…

4.3 MW natural gas-fired turbine supplies 100% of the hospital's electric and thermal energy needs

75% efficient at primary fuel conversion to useful energy

Lower emissions of nitrogen oxides and carbon dioxide as a result of state-of-the-art combustion turbine technology

Steam, produced by recycling the waste heat from the combustion turbine generator, produces useful thermal energy to meet the hospitals heating and cooling needs

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Energy Center Major Components

- 4.3 MW combustion turbine – Mercury 50
- Turbine exhaust diverter valve
- Heat Recovery Steam Generator – 14,500 lbs/hr (45,000 lbs/hr when supplemental fired)
- Steam turbine centrifugal chiller – 1,200 ton
- Combustion turbine Inlet cooling coils
- Thermal device exhaust stack
- Electrical centrifugal chillers – 2 @ 1,500 ton
- Chiller water variable primary pumps
- Packaged standby boiler – 30,000 lbs/hr
- Black start engine generator – 500 kW
- Emergency engine generator – 2,250 kW

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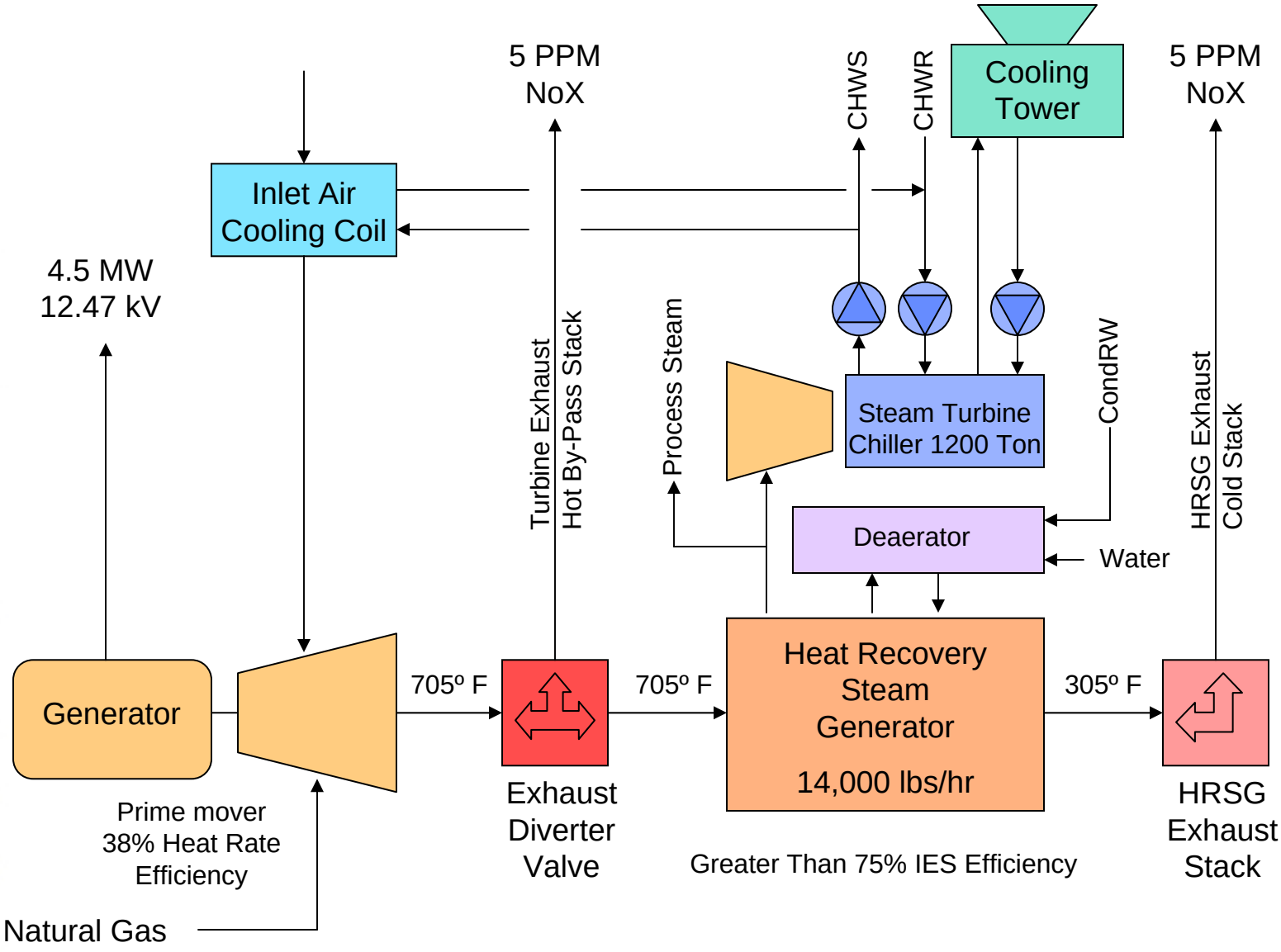
CHP System Components



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Environmental Comparison

CHP Results

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Annual Emissions Analysis					
	CHP System	Displaced Electricity Production	Displaced Thermal Production	Emissions/Fuel Reduction	Percent Reduction
NOx (tons/year)	4.14	75.60	1.46	72.92	95%
SO2 (tons/year)	0.10	158.71	0.05	158.66	100%
CO2 (tons/year)	19,515	36,425	9,519	26,430	58%
Carbon (metric tons/year)	4,825	9,006	2,354	6,535	58%
Fuel Consumption (MMBtu/year)	333,585	357,290	162,725	186,431	36%
Equivalent Acres of Pine and Fir Forests				5,446	
Equivalent Passenger Vehicles				4,365	

This CHP project will reduce emissions of Carbon Dioxide (CO2) by 26,430 tons per year

This is equal to 6,535 metric tons of carbon equivalent (MTCE) per year

This reduction is equal to the annual carbon stored by 5,446 acres of pine and fir forests

OR

This reduction is equal to the carbon emissions of 4,365 passenger vehicles per year

SOUTH ENERGY CENTER a GRU business

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LEED and CHP Efficiency

LEED-NC
LEED FOR NEW CONSTRUCTION

LEED-NC 2.2 Submittal Template
EA Credit 1: Optimize Energy Performance

Table 1.8.2(b) - Energy Cost and Consumption by Energy Type - Performance Rating Method Compliance

Energy Type	Proposed Design			Baseline Design			Percent Savings	
	Energy Use		Cost	Energy Use		Cost	Energy Use	Cost
Electricity	102,538	MBtu	0	120,388	MBtu	$3,310,718	14.8 %	0 %
Natural Gas	348,691	MBtu	$2,953,417	154,879	MBtu	$1,311,829	-125.1 %	-125.1 %
Purchased Steam	39,371	MBtu	0	1,113	MBtu	$8,904	-3,437.. %	0 %
	0			0			0 %	0 %
Subtotal (Model Outputs):	490,600	(MBtu/year)	$2,953,417	276,382	(MBtu/year)	$4,631,451	-77.5 %	36.2 %

On-Site Renewable Energy	Energy Generated	Renewable Energy Cost

Exceptional Calculations	Energy Savings	Cost Savings

	Proposed Design			Baseline Design			Percent Savings	
	Energy Use		Cost	Energy Use		Cost	Energy	Cost
Total:	490,600	(MBtu/year)	$2,953,417	276,382	(MBtu/year)	$4,631,451	-77.5 %	36.2 %

SOUTH ENERGY CENTER a GRU business

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Thank You for Your Attention

Ed Mardiat, DBIA
emardiat@burnsmcd.com
Chuck Heidt, PE
heidtcs@gru.com