SYSKA HENNESSY

Zeckendorf Green Power Project

DG Integration and Telecommunications Facility

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Sponsor: Department of Energy

ORNL Technical Project Officer: D. Tom Rizy

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Telecommunications Industry

Energy Needs

- ✍Highly Reliable (99.999%)
- ✍High Power Quality
- ✍Economical Costs

Concern:

How do we meet the high energy demands while reducing the cost?

Telecommunications Industry

Overview

End of 2001:

- ✍ 137M People Online (Equal to Half US Population)
- ✍ Current Power Grid Aging and Becoming Overtaxed
- ✍ 99.99% Reliable

Verizon:

- ✍ Merger between Bell Atlantic & GTE
- ✍ Services 63M domestic telephone lines
- ✍ 1999 and 2001 - Verizon experienced power disruptions which cost $100,000s in loss of production and damaged equipment.

Goal

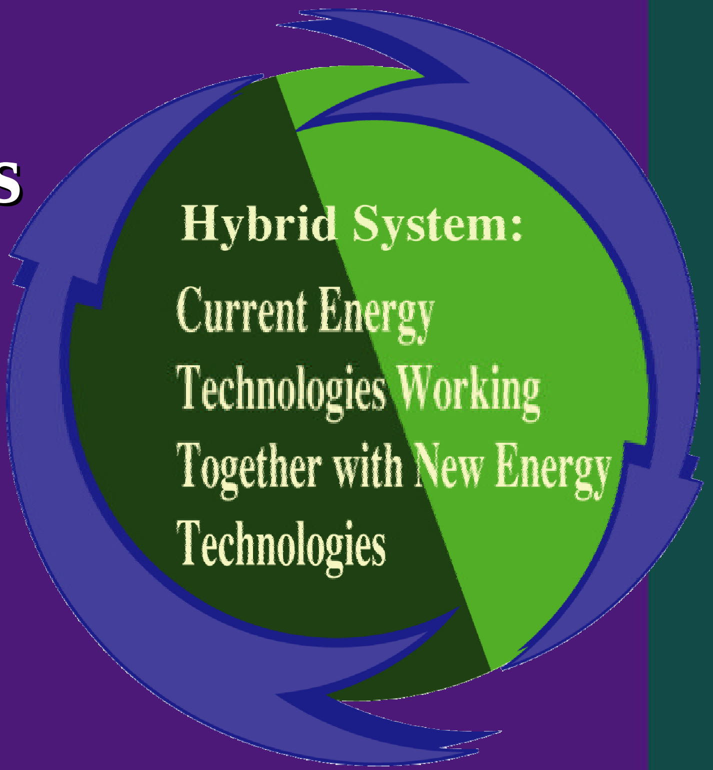
Create a Hybrid System

New Energy Technologies

- PAFC Fuel Cells

Current Technologies

- Reciprocal Natural Gas Fired Engine Generators



Zeckendorf Project

12 Tasks

1. Analyze Existing Electrical System
2. Evaluate Building Heating and Cooling System
3. Evaluate Heat Recovery Options
4. Assess Site Utilities
5. Develop Schematic Design
6. Develop Cost Estimate
7. Reliability Study
8. Permitting
9. Optimization
10. Utility Pricing Study
11. Emissions
12. Business Case Development

Zeckendorf Project

- Site Selection Process, Criteria:
  1. Critical Nature of Facility
  2. Ability to Duplicate System at Other Facilities
  3. Potential for Environmental and Energy Savings
  4. Cost Effectiveness

- High Environmental and Economic Costs in NY, Team Selects Zeckendorf Facility in Long Island
- High Electrical Costs and Low Natural Gas Costs Coupled with a History of Commercial Power Outages

Zeckendorf Project

- 330,000+ s.f. Single Story Facility (Combination of 80% Office and 20% Switching)
- Controls Communication Traffic Throughout Most of Long Island-(4 M Households & 125,000 Businesses)

Presently has:

- 3 – 500 Ton Electric Chillers (1 New/2 Need Replacement)
- 2 – 200 HP Boilers for Steam Heat
- 2 – 2.5 MW Combustion Turbines For Energy Stand-by Use

Energy Costs:

$2.35 Million/Yr.

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Concept

New Technology

Phosphoric Acid Fuel Cells

- ✍Highly Reliable
- ✍No Emission
- ✍Utilize Rejected Heat
- ✍Not Quick Responding
- ✍Requires Sync Signal

Current Technology

Gas Fired Reciprocating Engine Generators

- ✍Reliable
- ✍Low Emissions
- ✍Utilize Rejected Heat
- ✍Simple Design
- ✍Quick Response
- ✍Flexibility
- ✍Provides Sync Signal

Concept

How Do We Use This Hybrid System?

7 Fuel Cells

3 Engine Generators

→ Generates Power at:

4.4 MW Max

3.2 MW@N+1

✍Captured Waste Heat To Run 1 - 240 Ton Absorption Chiller

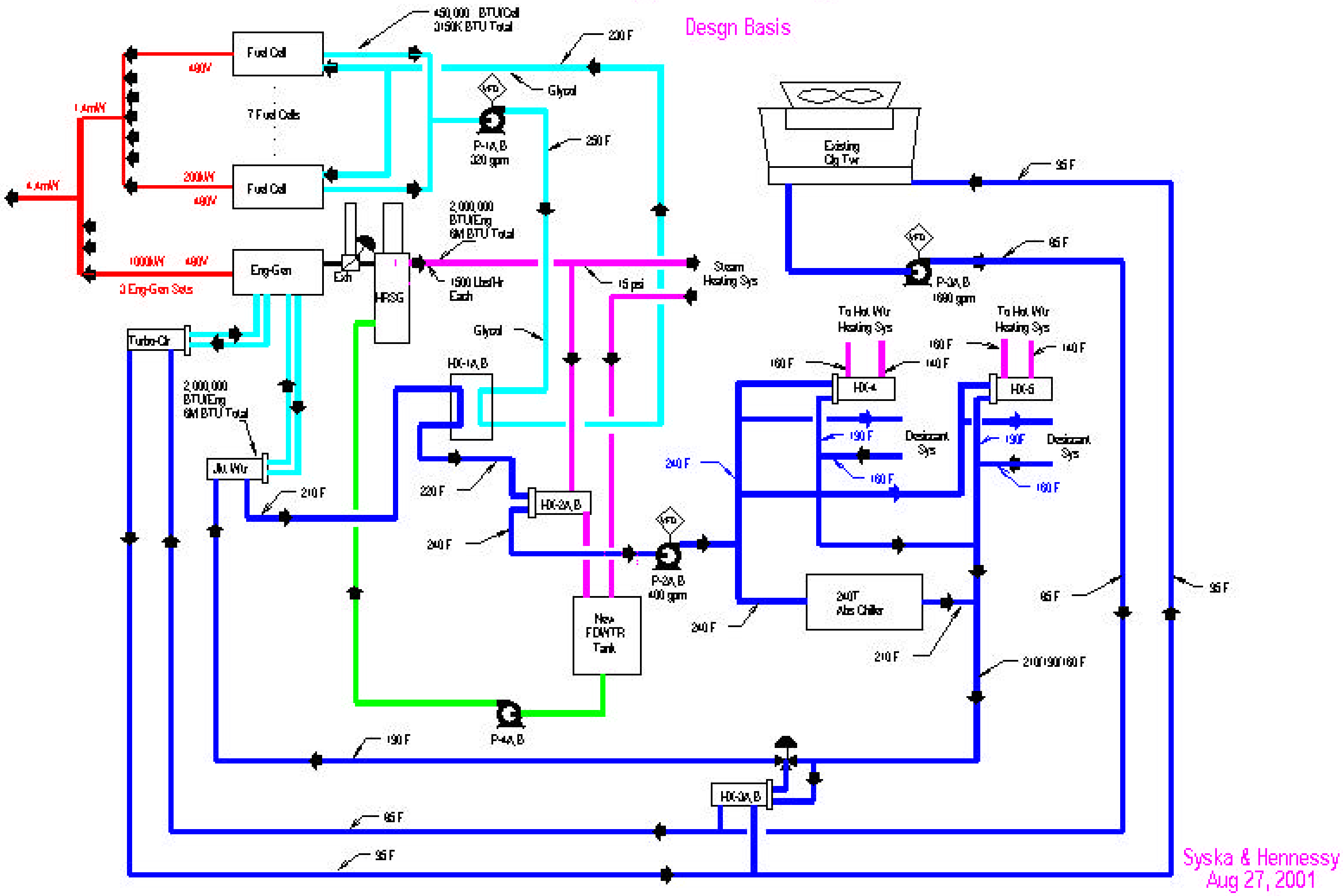
✍Additional Electric Centrifugal Fired Chiller (500 Ton)

Concept

Zeckendorf Green Power Project

Equipment and Flow Diagram

Desgn Basis



Syska & Hennessy
Aug 27, 2001

Operationally - 3 Goals

1. **Meet all Energy Demands (Electric, Chill, Heat)**
2. **Most Reliable Operation**
3. **Lowest Cost**

Learned

1. **Trade off Between Efficiency/Cost/Reliability**
2. **Expected an Over Abundance of Heat, But We Do Not Always Get it.**

Ran Two Basic Models

- Unconstrained Operation (Base Case)
  - 7 Fuel Cells
  - 1 Engine Generator
  - Equipment Limitations
- Operates the System to Get Lowest Cost
- Operates Engine Generator Sets at Highest Rate for Electric Production
- Will Not be Run that Way Because Fuel Cells are More Reliable

Constrained Operation

- Forces the Use of Fuel Cells at 50% (min) We Achieve 5.8% Improvement in Operating Costs
- If We Do Not Force Their Use We Can Achieve About 9% Improvement.

Results (Lessons Learned)

Financially

- **Direct Cost – $17 Million**
- **Payback in <6 Years w/Subsidy**
- **Without subsidies – Not economical**

Operationally

- **Total Energy Efficiency of Fuel Cells > Engine Generator**
- **If No Use for Waste Heat, Engine Generators are More Efficient for General Electric Purposes.**
- **Both Suffer Efficiency Degradation at Extreme High & Low Loads**
- **The Equipment in Use Must Match the Demands to Achieve Lowest Cost.**

Additional Results

Not Including the Use of the Waste Heat

Producing Power at or near Typical Peak Price in NY Area

We Do Not Utilize All Waste Heat Available.

Looking for a use for Low-Grade Heat.

Investigating the Use of Geothermal Heat Pumps and Heat Sinks.