SYSKA HENNESSY GROUP

Consulting + Engineering + Technology + Construction

Zeckendorf Hybrid Fuel Cell Green Power Project

Project Manager: Doug Peck – The Syska Hennessy Group

Sponsor: Department of Energy

ORNL Technical Project Officer: D. Tom Rizy

Telecommunications Industry

- High Reliability (99.999%)
- High Power Quality
- Economic 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
- Between 1999 and 2001Verizon experienced power disruptions which cost hundreds of thousands of dollars 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
Oak Ridge National Labs Subcontract 1/31/01
All Tasks are Complete, Final Report Submittal 7/02

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

Zeckendorf Facility

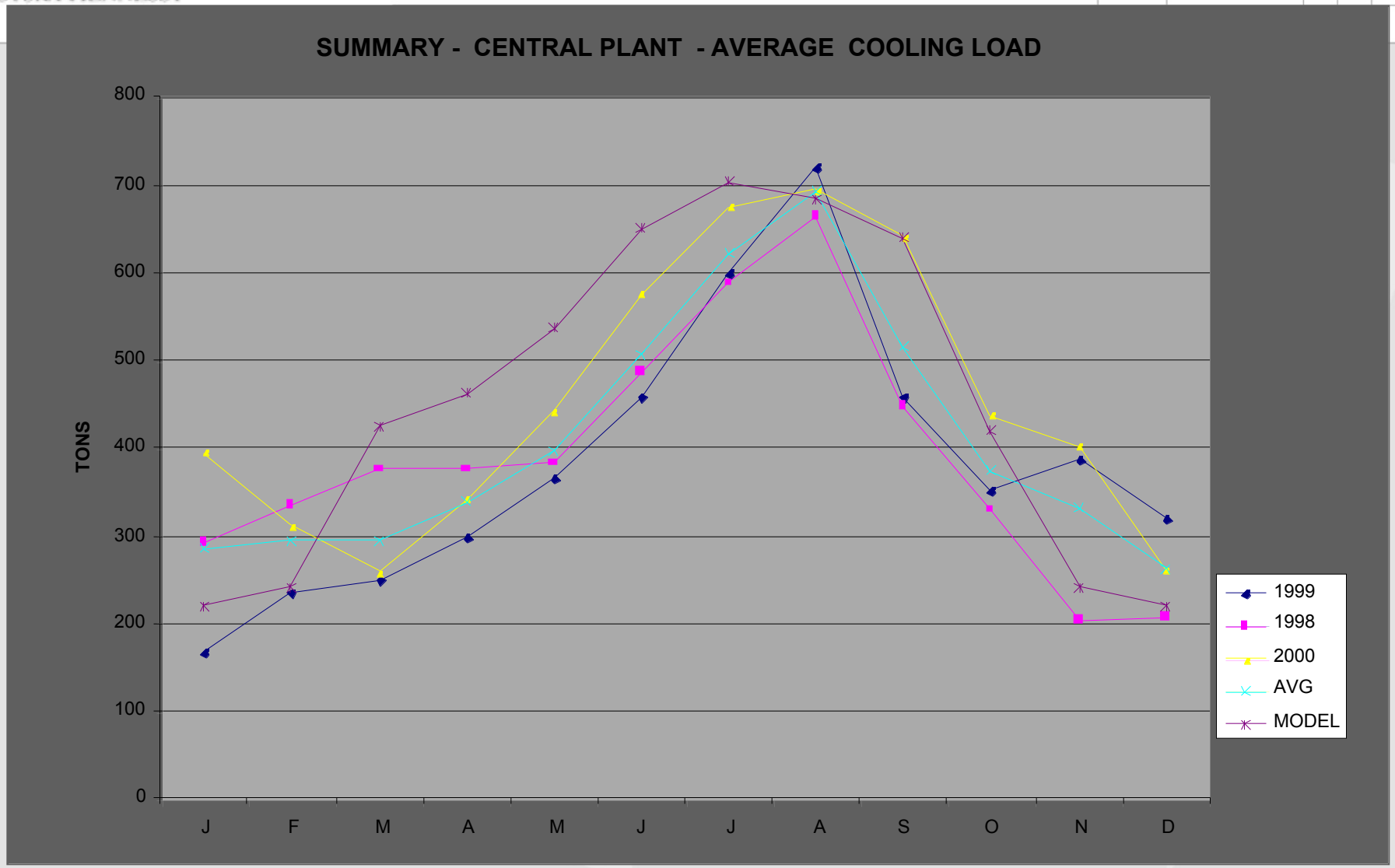
Zeckendorf Project

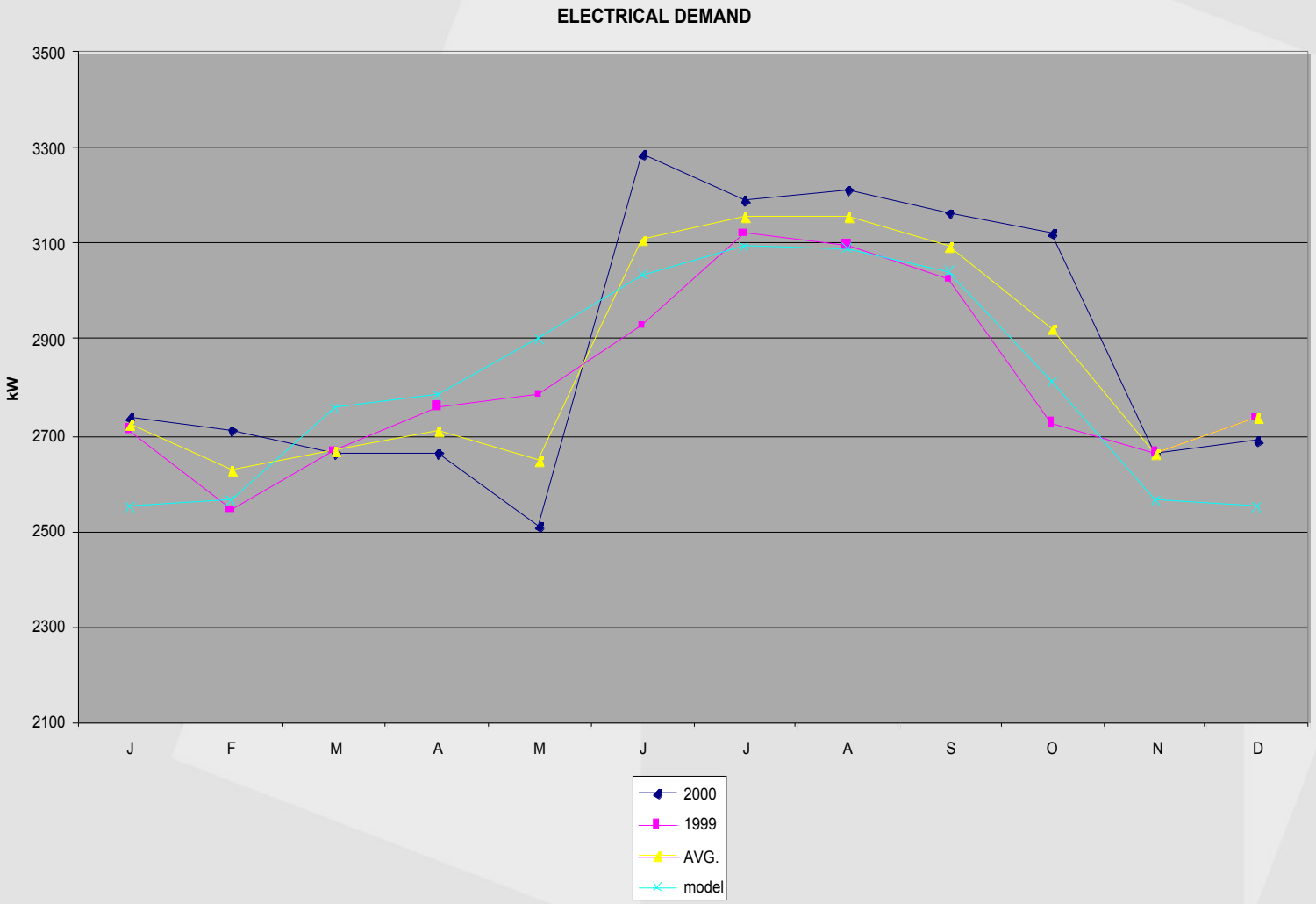
Zeckendorf Site – Garden City, Long Island, NY

- 330,000+ s.f. Single Story Facility
  (Combination of 80% Office and 20% Switching)
- Controls Communication Traffic Throughout
  Most of Long Island-(4 Million 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 Emergency Stand-by Use




ELECTRICAL DEMAND
3500
3300
3100
2900
2700
2500
2300
2100
kW
J
F
M
A
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J
A
S
O
N
D
2000
1999
AVG.
model

Concept

New Technology

Phosphoric Acid Fuel Cells

- ✓Highly Reliable
- ✓No Emission
- ✓Utilize Rejected Heat
- ✓Not Quick Responding
- ✓Requires Sync Signal
- ✓No Neutral Current

Current Technology

Gas Fired Reciprocating Engine Generators

- ✓Reliable
- ✓Low Emissions
- ✓Utilize Rejected Heat
- ✓Simple Design
- ✓Quick Response
- ✓Flexibility
- ✓Provides Sync Signal
- ✓Provides Neutral Current

Concept

How Do We Use This Hybrid System?

7 Fuel Cells

4 Engine Generators

2@1000 & 2@500 kw

→ Generates Power at: 4.4 MW Max

3.2 MW@N+1

✓Captured Waste Heat To Run 1 - 450 Ton Absorption Chiller

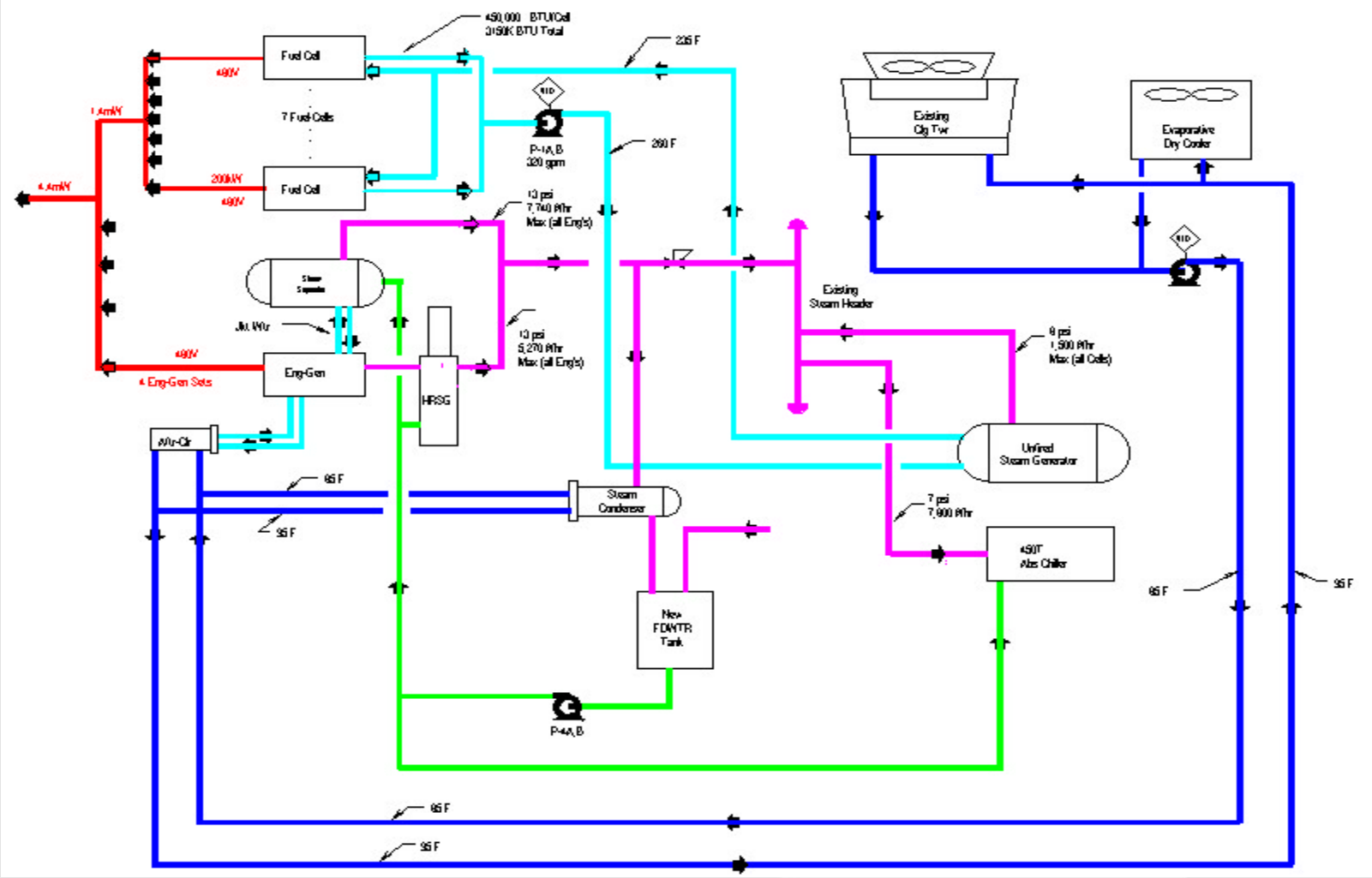
✓Additional Electric Centrifugal Fired Chiller (500 Ton)

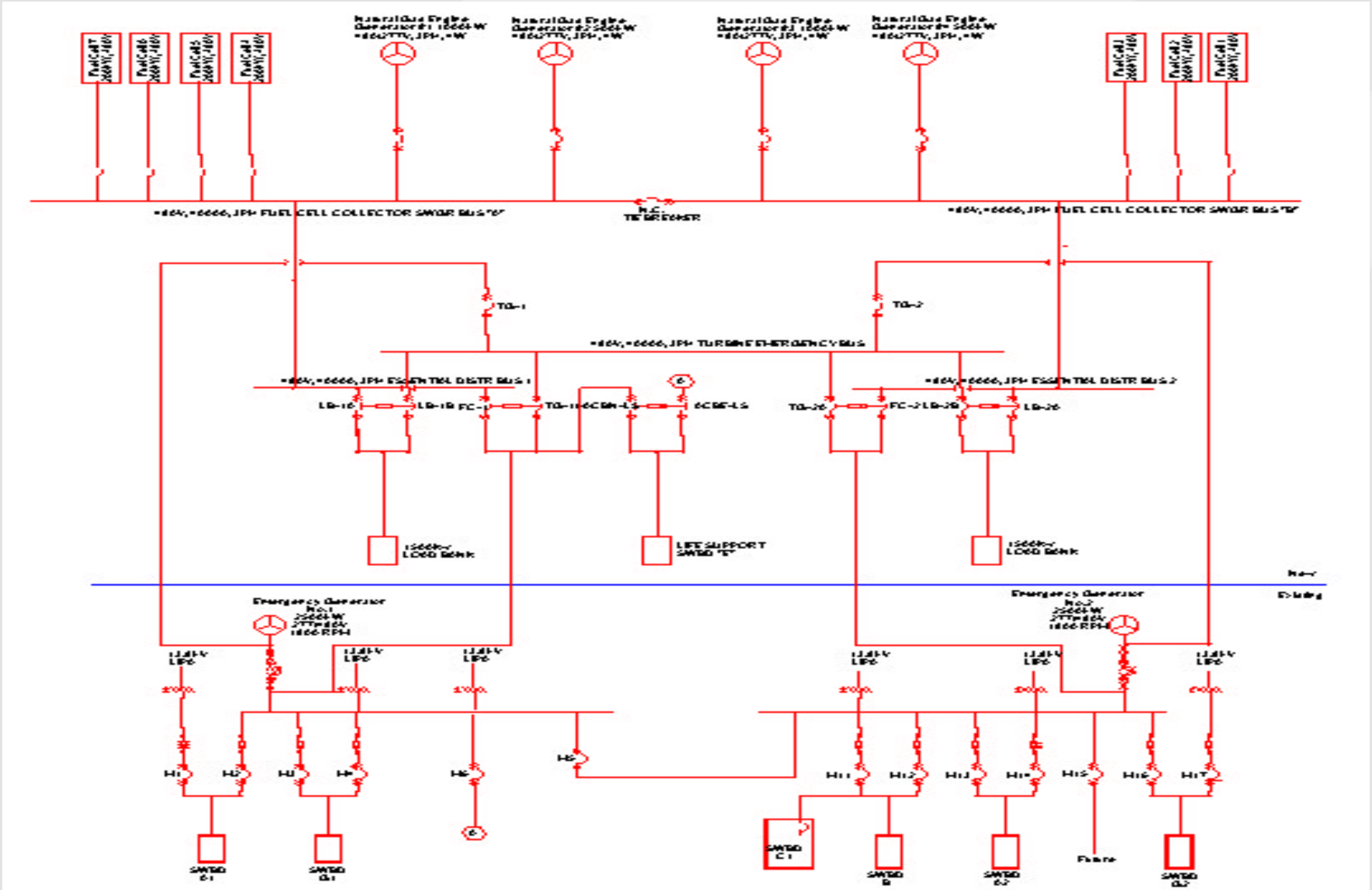
Concept

ONSI PC25

The 200kW PAFC manufactured by ONSI is 10'W x 18'L x 10'H. This consists of the fuel processor, cell stack, inverter, transformer, heat recovery, controls and diagnostics. Unit Weighs 20 Tons. A Supplemental cooling module is Included on roof

Concept





Operationally - We Try to Meet 3 Goals

1. Meet all Energy Demands (Electric, Chill, Heat)
2. Most Reliable Operation
3. Lowest Cost
    1. Trade off Between Efficiency/Cost/Reliability
    2. Will operate independent of the Utility Grid
    3. Must meet electric demand at all times
    4. Switch-over to standby Eng-Gen is Automatic
    5. Switch to utility is Manual

Results (Lessons Learned)

Reliability

Being able to suffer the loss of power to the bus for <1 Min

Reliability is > 99.9999%

Operationally

Total Energy Efficiency of Fuel Cells > Engine Generator

If No Use for Waste Heat, Engine Generators are More Efficient for Generating Electrical Power.

Always Run a Minimum of 2 Eng-Gen Sets. Fuel Cells always loaded between 70 and 95%.

Electrical Loading

Facility Load	2000 kW		2100kW		2200 kW		2300 kW		2400 kW		2500 kW		2600 kW		2700 kW		2800 kW		2900 kW		3000 kW	
7-200 KW Fuel Cells	1120	80%	1200	86%	1000	71%	1100	79%	1100	79%	1150	82%	1250	89%	1300	93%	1000	71%	1100	79%	1100	79%
1000 KW Engine #1	0	0%	0	0%	800	80%	800	80%	850	85%	900	90%	900	90%	950	95%	900	90%	900	90%	950	95%
500 KW Engine #2	440	88%	450	90%	400	80%	400	80%	450	90%	450	90%	450	90%	450	90%	0	0%	0	0%	0	0%
1000 KW Engine #3		0%		0%		0%		0%		0%		0%		0%	0	0%	900	90%	900	90%	950	95%
500 KW Engine #4	440	88%	450	90%		0%		0%		0%		0%		0%		0%		0%		0%		0%
Total Power Produced (kW)	2000		2100		2200		2300		2400		2500		2600		2700		2800		2900		3000	

Facility Load	3000 kW		3100 kW		3200 kW		3300 kW		3400 kW		3500 kW		3600 kW		3700 kW		3800 kW		3900 kW		4000 kW	
7-200 KW Fuel Cells	1100	79%	1200	86%	1300	93%	1350	96%	1150	82%	1250	89%	1300	93%	1400	100%	1400	100%	1200	86%	1300	93%
1000 KW Engine #1	950	95%	950	95%	950	95%	1000	100%	900	90%	900	90%	900	90%	900	90%	950	95%	900	90%	900	90%
500 KW Engine #2	0	0%	0	0%	0	0%	0	0%	450	90%	450	90%	500	100%	500	100%	500	100%	450	90%	450	90%
1000 KW Engine #3	950	95%	950	95%	950	95%	950	95%	900	90%	900	90%	900	90%	900	90%	950	95%	900	90%	900	90%
500 KW Engine #4		0%		0%		0%		0%		0%		0%		0%		0%		0%	450	90%	450	90%
Total Power Produced (kW)	3000		3100		3200		3300		3400		3500		3600		3700		3800		3900		4000	

Schedule

- Engineering
  - 1st Phase –Produce 70% package
    - To be complete in August 2002
  - 2nd Phase – Produce 100% package
    - To be complete in Nov 2002
- Contractor Mobilization - December 2002
- Mechanical Completion – September 2003
- Switchgear Completion – October 2003
- Ready for Operation – November 2003

- Be On-Line Before End of 2003