The SCRIPPS Research Institute
Florida Atlantic University

BIOMEDICAL RESEARCH BUILDING

JUPITER, FLORIDA

PRESENTED BY:
ADAM HOUCK
CONSTRUCTION MANAGEMENT OPTION
WEDNESDAY, APRIL 22, 2009
OVERVIEW

PROJECT LOCATION AND SIZE
Jupiter Florida, Florida Atlantic University Jupiter Campus

OCCUPANCY AND FUNCTION
The SCRIPPS Research Institute – Biomedical Research

SIZE
132,675 GSF

Construction SCHEDULE
August 2006 – January 2009

CONTRACT SIZE $358.25/SF
$47.53 M GMP
project OVERVIEW

project TEAM

OWNER
SCRIPPS

ARCHITECT – Joint Venture
Zeidler Partnership Ltd. & Bohlin Cywinski Jackson

CONSTRUCTION MANAGER
FLUOR

GENERAL CONTRACTOR
WEITZ - DPR
project OVERVIEW

project FEATURES

1st Floor
Vivarium, CUP, Loading Dock, Mechanical Yard

2nd & 3rd Floors
Research Laboratories, Offices, Common Area

3 Story Atrium at the Main Entrance

4th Floor
Mechanical Penthouse
analysis TWO

Co-Generation plant

BACKGROUND
FPL supplies the campus with its power

PROPOSAL
Add Co-Generation plant to supply the building needs

GOALS
Reduce Electrical Demand of the Building
Produce Electrical, Heating & Cooling Demands of the Building
Reduction of Carbon Footprint
Mitigate Up-Front Investment Through Payback & Savings Analysis
**DESIGN methodology**

**As-Designed Building Loads**

<table>
<thead>
<tr>
<th>Thermal Loads</th>
<th>Electrical Loads</th>
<th>Thermal/Electric Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Hot Water Boilers 7,300 MBH</td>
<td>Electrical Load 5.67MW</td>
<td>21,440,000 BTU/hr 19,359,688 BTU/hr 1.107</td>
</tr>
<tr>
<td>2 Steam Boilers 12,500MBH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Chillers 1,300Tons</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sizing Design Conditions for Intake Air Cooling**

- Outdoor Air Design Conditions:
  - 95°F @60%RH
  - $T_{dp}$ = 78°F
  - w = 0.022

- Desired Supply Air Conditions:
  - $\forall$ = 30,000 cfm $\leftrightarrow$ 60°db 80%RH
  - $\dot{m}$ = 2.300 lb/min $h$ = 24 BTU/lbm
  - $w$ = 0.009 lbm H₂O/lbm air
  - $\rho$ = 13.1 lbm ³

**Utility Information**

Customer Charge – $375.00/Month

<table>
<thead>
<tr>
<th>ON – PEAK</th>
<th>CHARGES</th>
<th>OFF – PEAK</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.00634/kW</td>
<td>BASE</td>
<td>$0.00508/kW</td>
</tr>
<tr>
<td><strong>$0.05928/kW</strong></td>
<td>NRG</td>
<td><strong>$0.05432/kW</strong></td>
</tr>
<tr>
<td>$0.00071/kW</td>
<td>Environmental</td>
<td>$0.00071/kW</td>
</tr>
<tr>
<td>$0.00012/kW</td>
<td>Storm</td>
<td>$0.00012/kW</td>
</tr>
<tr>
<td>$0.00160/kW</td>
<td>Conservation</td>
<td>$0.00160/kW</td>
</tr>
<tr>
<td><strong>$5.90000/kW</strong></td>
<td>Demand</td>
<td><strong>$5.90000/kW</strong></td>
</tr>
<tr>
<td>$3.08000/kW</td>
<td>Capacity</td>
<td>$3.08000/kW</td>
</tr>
</tbody>
</table>

*The 1\textsuperscript{st} Boxed # is the amount we will be paid by the utility for power supplied back to the grid, the 2\textsuperscript{nd} boxed # is the amount we will be paid by the grid for having power available whenever they need it.*
analysis RESULTS

Design IMPACT

Electrical Supply Requirements
• 4.952 MW
  Originally 5.67 MW

Electrical Supply Capacity
• 5.2 MW
  Turbine & pressure reducing Steam Turbines

Steam Supply Requirements
• 56,500 PPH

Steam Supply Capacity
• 104,400 PPH

• Produce All Electricity On Site with Turbine
  - eliminate grid dependence

• Produce All Steam, Cooling & HW Requirements with Turbine
  - Cooling done utilizing Absorption Chillers run by steam from turbine
### COST analysis

#### Total Savings

*After Re-Design Yearly Totals*

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>TOTAL $</th>
</tr>
</thead>
<tbody>
<tr>
<td>[-] Natural Gas Bill</td>
<td>$349,979.52</td>
</tr>
<tr>
<td>[+ ] Amt Saved from Redesign</td>
<td>$953,187.23</td>
</tr>
<tr>
<td>[+ ] Income From Utility</td>
<td>$1,091,550.00</td>
</tr>
<tr>
<td><strong>TOTAL [+ ]</strong></td>
<td><strong>$1,694,757.71</strong></td>
</tr>
</tbody>
</table>

#### Payback

<table>
<thead>
<tr>
<th>Project Cost</th>
<th>Annual Operating Cost</th>
<th>Net Savings</th>
<th>Simple Payback</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5,058,593.00</td>
<td>$349,979.52</td>
<td>$1,694,757.71</td>
<td>3.0 yr</td>
</tr>
</tbody>
</table>

$1.7 Million/yr
ACKNOWLEDGEMENTS

SAUER, INC.

ISEC, INC.

FLUOR

AE FACULTY

BRIAN AULT

MY FIANCE, FRIENDS & FAMILY
Co-Generation calculations

Steam Requirements & Steam Turbine Power Calculation

3,412 BTU/hr = 1 kW

2000 tons @ COP = 0.75 = 2670 “Tons” of steam
= 32,040,000 BTU/hr
@ 5 psig steam, \( h_f \gamma = 960 \frac{BTU}{lbm} \)
= 33,400 lb/hr 5 psig steam

@ 150 psig, \( h_g = 1195.1 \frac{BTU}{lbm} \)
@ 100 psig, \( h_g = 1190 \frac{BTU}{lbm} \)
@ 5 psig, \( h_g = 1156.1 \frac{BTU}{lbm} \)

\[ Q_{out} = (1300 \frac{lbm}{hr})(1195.1 - 1190 \frac{BTU}{lbm}) = 66,300 \frac{BTU}{hr} \]
\[ Q_{out} = (43,400 \frac{lbm}{hr})(1195.1 - 1156.1 \frac{BTU}{lbm}) = 1,692,600 \frac{BTU}{hr} \]

= 1,758,900 BTU/hr
= 2,000,000 BTU/hr

~ 590 kW “extra” @ Steam Turbine

NG Req. for Turbine & Duct Burner

Fuel in = 40.5 \( \frac{MMBTU}{hr} \) @ GT
+ 94.8 \( \frac{MMBTU}{hr} \) @ Duct Burner

= 135,300 \( \frac{BTU}{hr} \) Total

= 135,300 ft³ \( \frac{NG}{hr} \)

= 2,255 cfm NG @ 300 psig
Co-Generation calculations

Calculating the cost comparison of the two systems with respect to Billing Amounts

$0.88/Therm = 1,000,000 Btu

Gas Turbine NG Requirements — Running the turbine at 63% capacity at all times producing 3 MW = \( 26.4 \frac{\text{Therms}}{\text{hr}} \)

\[
\left( \frac{8760}{\text{yr}} \right) \left( 26.4 \frac{\text{Therms}}{\text{hr}} \right) = 231,264 \frac{\text{Therms}}{\text{yr}}
\]

Duct Burner NG Requirements — Running the burner at 40% capacity for half the year to meet additional steam requirements for the Absorption Chiller requirements = \( 38 \frac{\text{Therms}}{\text{hr}} \)

\[
\left( \frac{4380}{\text{yr}} \right) \left( 38 \frac{\text{Therms}}{\text{hr}} \right) = 166,440 \frac{\text{Therms}}{\text{yr}}
\]

Adding these two numbers you come up with a total of 397,704 \( \frac{\text{Therms}}{\text{yr}} \).

This would cost $349,979.52 /yr

According to the Billing Information — The demand is approximately 1.1 MW at all times. Running our Turbine to produce 3 MW at all times means that we will be supplying 1.9 MW to the grid.

\[
\frac{(1900\text{kW})(8760\text{hr}) \left( \frac{$0.0575}{\text{kWh}} \right)}{\text{yr}} = $957,030/\text{yr}
\]

There will also be an income amount based on the available demand to the grid

\[
(1900\text{kW}) \left( \frac{$5.90}{\text{kW/\text{Month}}} \right) (12 \text{ Months}) = $134,520/\text{yr}
\]