

Santa Catalina.....



..... *the Island of Romance*



..... and One Lonely Microturbine.....

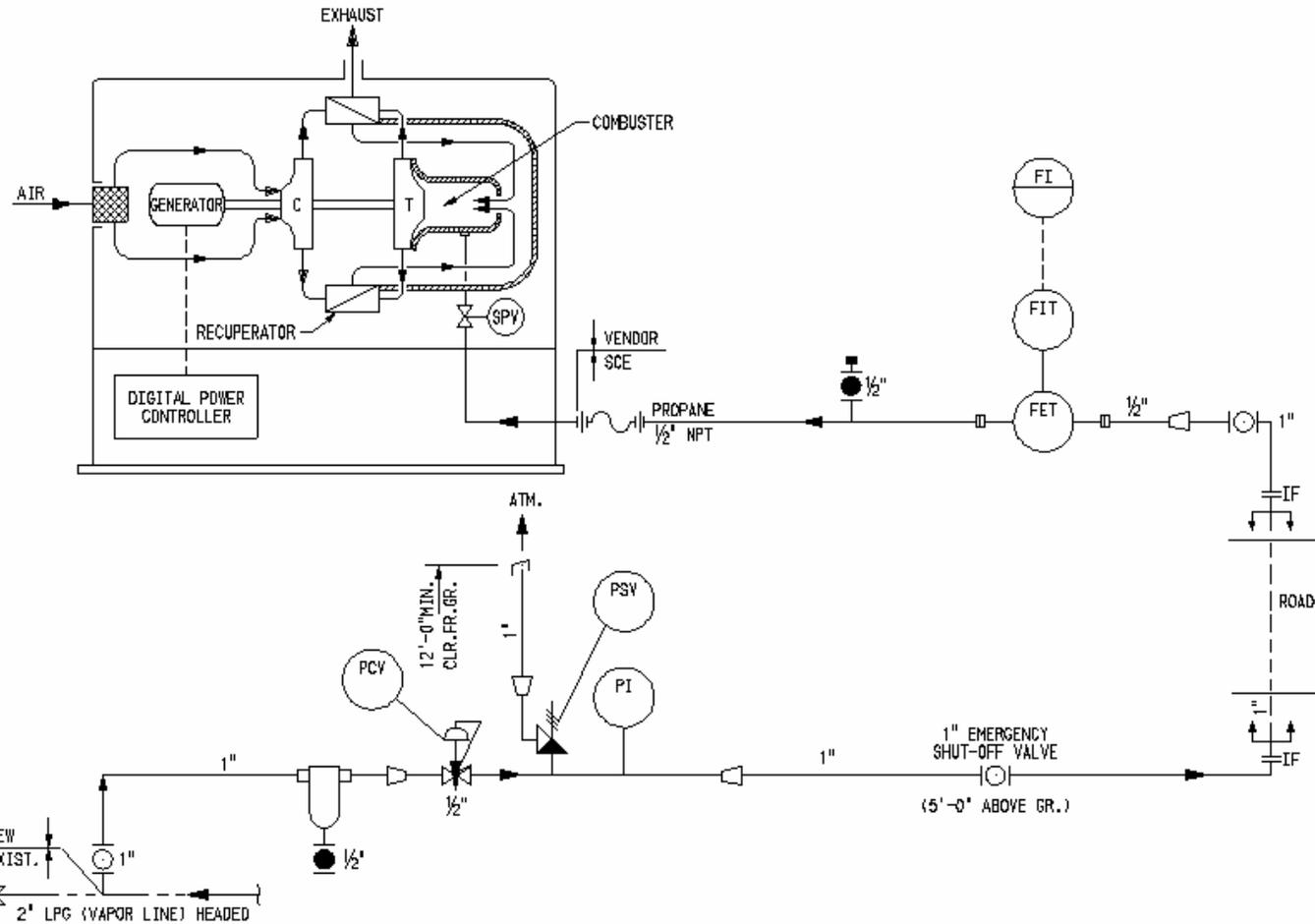


Background

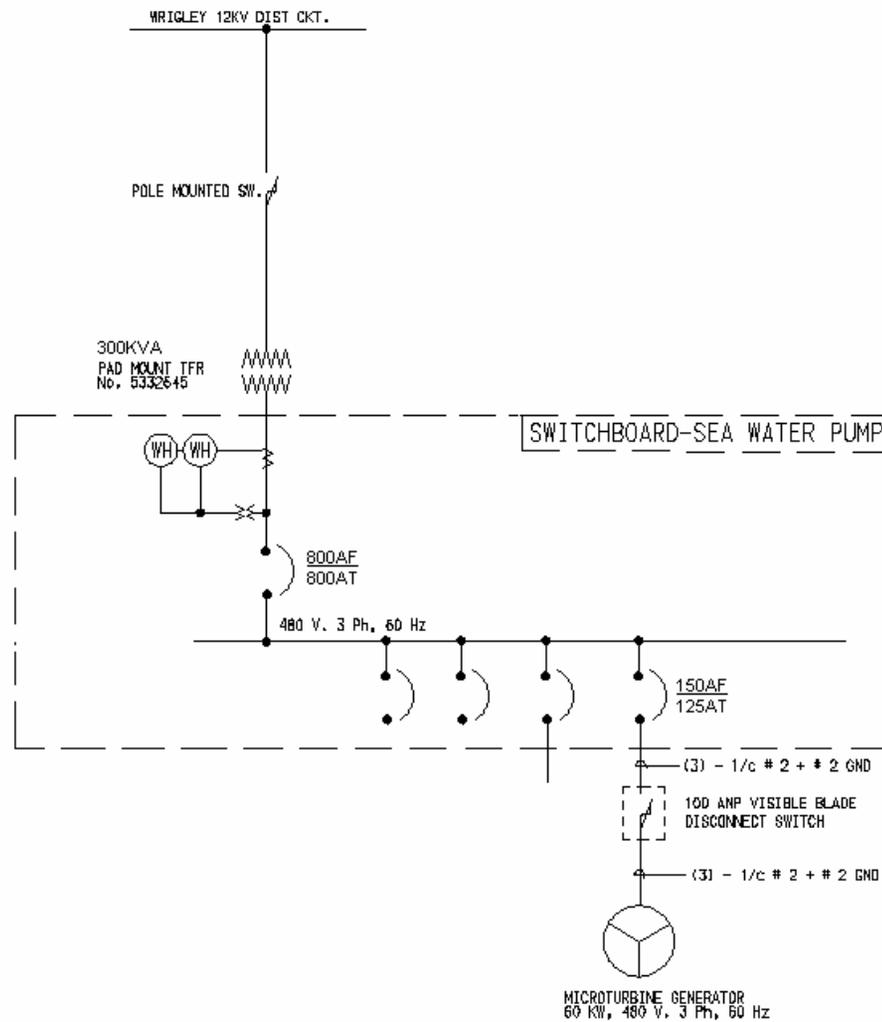
- Capstone C60 Microturbines Offered to SCE by Southern California Air Quality Management District
- SCE Received One Unit for Test and Evaluation:
 - Harsh Marine Environment (20 Feet from Pacific Ocean)
 - Air Emission Offset for Existing Diesel Generators
 - Fuel/Cost Savings
 - Maintenance Savings
 - Operating Flexibility
- Installed and Initiated Operation in November 2003



Mechanical Arrangement

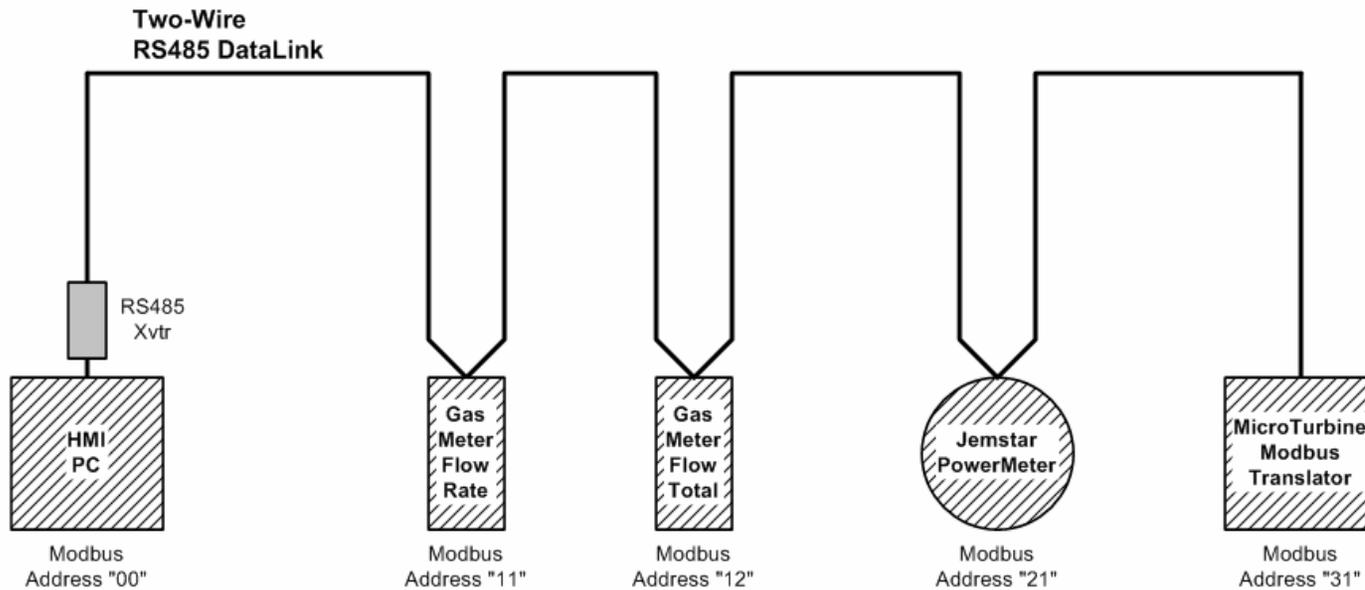


Electrical Arrangement

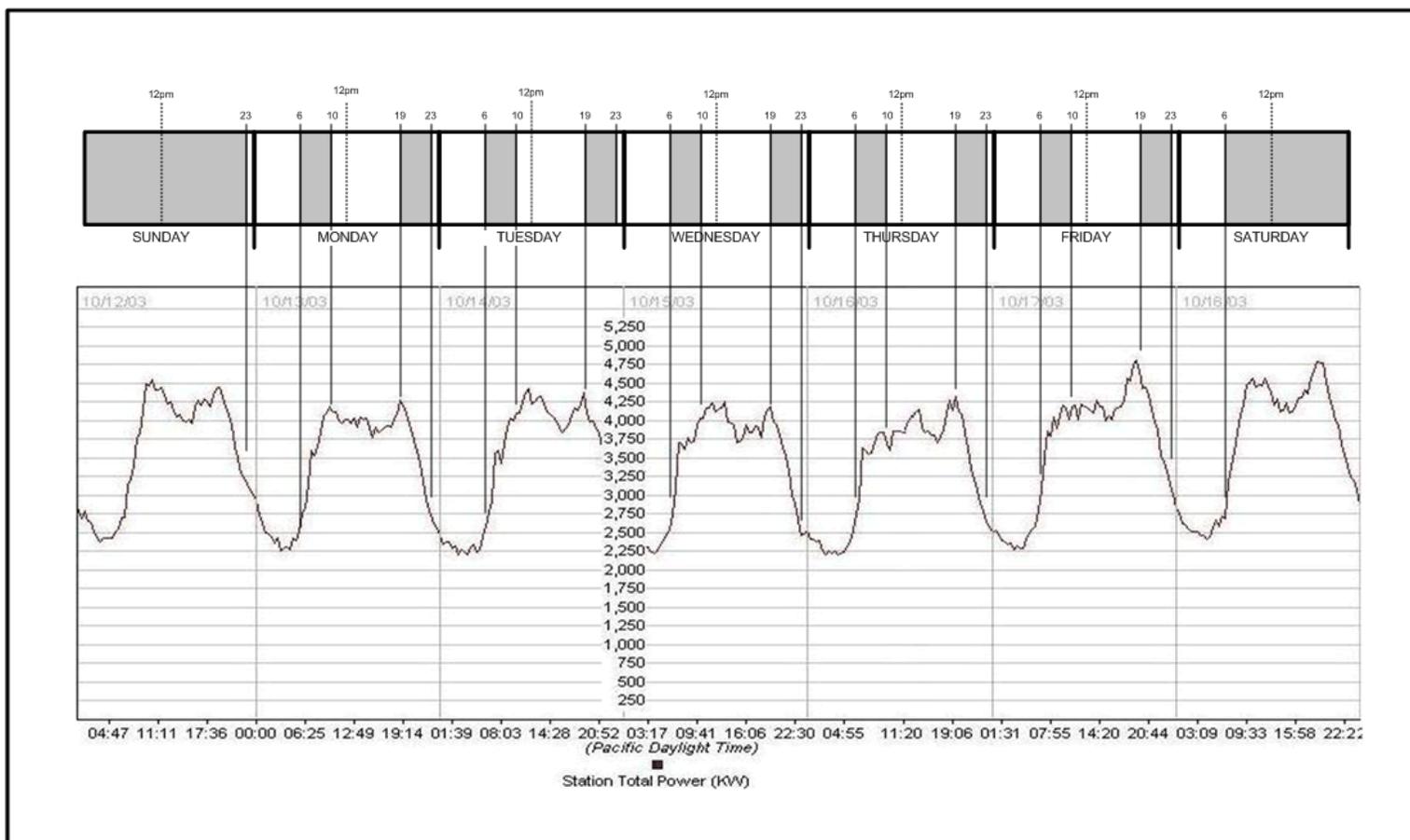


Control System Arrangement

PROTOCOL:
Modbus RTU, 9600 Baud
8 Data Bits, No Parity, 1 Stop Bit



Weekly Test Operating Schedule



Propane Fuel Characteristics

VAPOR PRESSURE OF LIQUID PROPANE AT VARIOUS TEMPERATURES

Temperature of Liquid (F)	Approximate Pressure of Gas (PSI)
-40	1.3
-30	5.5
-20	10.7
-10	16.7
0	23.5
10	31.3
20	40.8
30	51.6
40	63.3
50	77.1
60	92.5
70	109.3
80	128.1
90	149.3
100	172.3
110	197.3

Manufacturer's suggested microturbine fuel inlet pressure is 75 - 80 psig for methane. On propane, the fuel inlet pressure has been reduced to 60 psig.



Initial Operating Performance*

TIME	LOAD MW	KWH	SCF	SCFH	T1 oF	TET oF	RPM	FUEL PRESS Psig	REGUL PRESS Psig	TANK TEMP oF	TANK PRESS Psig	THD VA %	THD AA %	Other	REMARKS
8:53	60.0	698.8	3628.23	270	71	1175	92700	68.2	72	46.5	85	0.0	0.0		
9:03	60.0	709	3675.50	275	72	1174	93200	68.2	72	46.5	85	0.0	0.0		
9:20	60.0	725.6	3752.56	278	77	1175	93500	68.2	72	47	85	0.0	0.0	54	LPG Tk Temp, oF
9:30	60.0	736.2	3802.50	278	73	1175	93600	68.2	72	47	85	0.0	0.0	14.4	Ambient psia
10:10	49.8	26	3968.60	227	76	1175	88900	69.6	73	47.5	85	0.0	0.0		
10:20	49.8	37.4	4021.00	227	76	1174	88800	70.1	73	47.5	85	0.0	0.0	55	LPG Tk Temp, oF
10:40	49.8	53.3	4094.50	227	77	1174	88800	70.1	73	47.5	85	0.0	0.0	14.4	Ambient psia
10:50	40.0	61.5	4131.96	178	76	1175	83900	71.5	74	48	85	0.0	0.0		
11:05	40.0	71.5	4177.22	175	75	1174	83700	71.5	74	48	85	0.0	0.0	56	LPG Tk Temp, oF
11:15	40.0	76	4197.33	175	74	1174	83650	71.5	74	48	86	0.0	0.0	14.4	Ambient psia
11:20	30.0	81.5	4221.50	126	76	1174	78500	72.9	76	48.5	86.5	0.0	0.0	56	LPG Tk Temp, oF
11:40	30.0	88.3	4250.39	127	75	1174	78500	72.9	76	49	87	0.0	0.0	14.4	Ambient psia
11:55	30.0	95.2	4279.30	125	74	1174	78300	73.4	76	49	87	0.0	0.0	65	Prop pipe temp at FE

*Fuel metering not adjusted for temperature or pressure.



Emission Characteristics

Microturbine	Capstone C60	
Test date	2/11/2004	11:00 through 11:30 AM
Load	60 KW	
Analyzer	Delta mobile lab	
Analyzer Calibration	22 ppm cal gas	
CO	5 ppm	
O2	17.5 %	
NOx	13 ppm	
NOx corrected to 15% O2	22.6 ppmc	



Continued Operation (post-Testing) Findings

Operating the current single unit at maximum capacity factor results in significant annual savings without additional capital expenditures. Assuming a maximum capacity factor of 90% is possible, essentially running the unit full time with outages for routine maintenance only, the savings components **based on 2003 dollars and fuel costs** are as follows:

Annual MT Savings Summary in \$/Year:

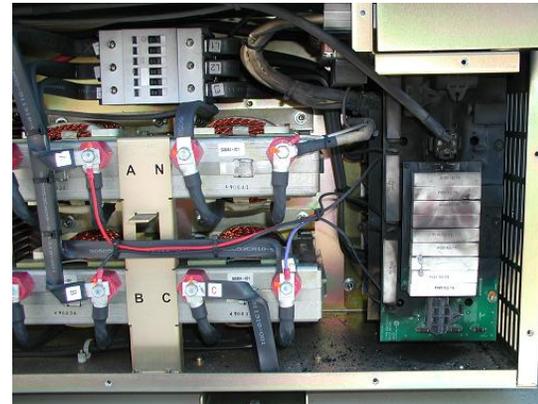
Fuel Savings	\$7,900
Urea Savings	\$3,800
NOx RTC Sales	\$4,500
Emission Fee Reduction	\$500
O&M Reduction	\$12,800
<u>Total "Savings"</u>	<u>\$29,500</u>



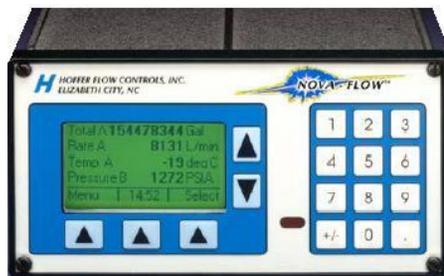
Equipment Challenges



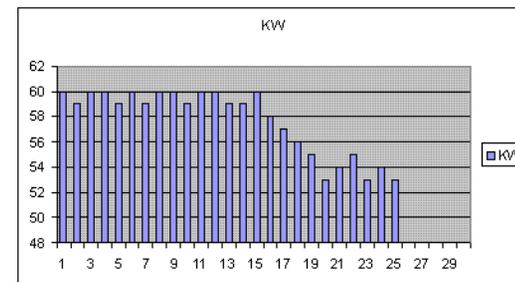
IGNITOR FAILURE



ENGINE & LOAD CONTROL MODULE FAILURES



FLOWMETER FAILURE



DECLINING UNIT CAPACITY



Current Status

- Microturbine Still in Service 26 Months After Original Installation
- Over 12,000 Hours of Operation
- Over 340 Unit Starts
- Maximum Generating Capacity is 55 KW
- No Apparent Ill Effects from Propane Fueling



It's A Beautiful Day In the Neighborhood...

