Minto Place Suite Hotel Microturbine Commissioning Experience

SPONSORS

MINTO DEVELOPMENT INC:
ANDREW PRIDE
ENBRIDGE GAS DISTRIBUTION:
TERRY WHITEHEAD
ONTARIO POWER GENERATION:
MARK TINKLER
CANMET ENERGY TECH CENTRE/
NATURAL RESOURCES CANADA:
ROB BRANDON

INSTALLATION AND COMMISSIONING TEAM

MINTO ENERGY MANAGEMENT:
ROBERT SMITH
CANMET ENERGY TECH CENTRE/
NATURAL RESOURCES CANADA:
BRYAN HALLIDAY
SYLVAIN DEROME
RANDY BIGGS
ENVIRONMENT CANADA:
DAVID E. VILLARROEL
RUHNKE CONSULTING INC:
WAYNE RUHNKE

Project Schedule

S	M	T	W	TH	F	S
			PLAN		ACTUAL	
EQUIPMENT DELIVERY			DEC '02		OCT '03	
SYSTEM COMMISSION			FEB '03		AUG '04	
MONITORING UNDERWAY			FEB '03		SEP '04	

	ACTUAL $	HINDSIGHT $	50th Install $
Turbine	24 000	24 000	24 000
CHP Unit - Unifin	10 700	10 700	10 700
Mechanical	12 000	12 000	8 000
Electrical	8 400	6 400	5 600
Civil	3 200	3 200	3 200
Consulting	4 000	4 000	4 000
Project Management	1 600	1 600	1 600
TOTAL	63 900	61 900	57 100

ALL IN US$

Maintenance Costs

EVERY 8000 HRS:
MATERIALS: ENGINE AIR FILTER, INLET FUEL FILTER, IGNITOR AND BATTERY.
COST: $1044
LABOUR/EXPENSES: $1972
TOTAL COST: $3016 ($0.0171/kWh)

AFTER 16000 HRS:
MATERIALS: AS ABOVE PLUS ELECTRONIC AIR FILTERS, INLET FUEL FILTER, INJECTOR ASSEMBLIES, THERMOCOUPLE.
COST: $3646
LABOUR/EXPENSES: $2889
TOTAL COST: $6535 ($0.037/kWh)

AFTER 24000 HRS:
MATERIALS: SAME AS 8000 HRS
COST: $1120
LABOUR/EXPENSES: $2077
TOTAL COST: $3197 ($0.018/kWh)

ECONOMIC$$

PRICE OF NATURAL GAS: $0.28 / CUBIC METER
ELECTRICITY RATE: $0.0376 / KWh
OPERATING HOURS (90% AVAILABILITY):
8000 HRS
MAINTENENCE COSTS: $0.0171 / KWh
(NOTE: TO CALCULATE COSTS A $0.01/kWh MAINTENANCE RATE IS USED)
OPERATING COSTS: $0.1431 / KWh

REVENUE		
ELECTRICITY		$6,610.98
DEMAND SAVINGS	$4,134.05	
THERMAL	$17,393.04	
	$28,138.07	
COST		
FUEL	$25,174.80	
MAINTENANCE	$1,758.24	
	$26,933.04	
NET TOTAL		$1,205.03

ALL IN US$ US$0.8 = CDN$1

UTILITY GATEWAY SYSTEMS

UGS PROVIDES A REAL TIME INTERNET BASED ENERGY MONITORING, MANAGEMENT AND REPORTING SYSTEM.

THIS SYSTEM PROVIDES A USER FRIENDLY GRAPHIC WEBSITE TO MONITOR ENERGY PRICES AND UNIT PERFORMANCE. DATA IS GATHERED WITH EXISTING ONSITE METERS AND RECORDED IN EASY TO READ TABLES. DAILY, MONTHLY, AND YEARLY INFORMATION IS ACCESSIBLE FOR AN OPERATOR OR MANAGER'S USE.

THE COST OF NRCAN'S 3 YEAR CONTRACT WITH UGS IS $14,000.

INSTITUTIONAL EXPERIENCE

THE APPROVALS THAT WERE REQUIRED FOR THE PROJECT WERE TSSA, ESA, and HYDRO OTTAWA

NRCAN MADE A SIGNIFICANT CONTRIBUTION TO LESSEN THE OVERHEAD BURDEN WHEN OBTAINING APPROVALS.

HYDRO OTTAWA WAS HELPFUL AT INVESTIGATING THE CAPACITOR SWITCHING ISSUE.

SUPPLIER SUPPORT

CAPSTONE'S STAFF WERE UNABLE TO RESOLVE THE TRIPPING DUE TO UTILITY CAPACITOR SWITCHING. THE TURBINE SOFTWARE STILL ALLOWS OCCASIONAL (1-2 / WEEK) TRIPPING.

AN ELECTRICAL CONSULTANT IS INVESTIGATING A SOLUTION TO THE TRIPPING PROBLEM.

RUHNKE CONSULTING INC WAS A VITAL PARTNER DURING COMMISSIONING.

GENERAL EXPERIENCE

AREAS THAT NEED IMPROVEMENT FOR FUTURE PROJECTS:
- A RESOLUTION OF REMAINING GAS AND ELECTRICAL CODE ISSUES IN ONTARIO
- INSTALLATION OF A THREE WAY VALVE TO LIMIT HEAT EXCHANGER CORROSION
- INTEGRATION WITH HOTEL CONTROL SYSTEMS, AND COORDINATION WITH HOTEL STAFF.

R&D AREAS TO LOOK AT INCLUDE:
- PRE-HEATING OF INCOMING WATER TO REDUCE CORROSION EFFECTS
- A COMPLETE HOTEL CHP PACKAGE SPECIFIC FOR DHW SYSTEMS

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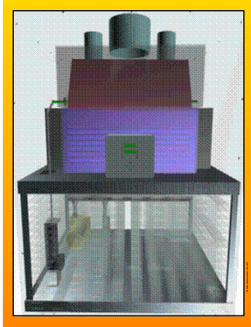
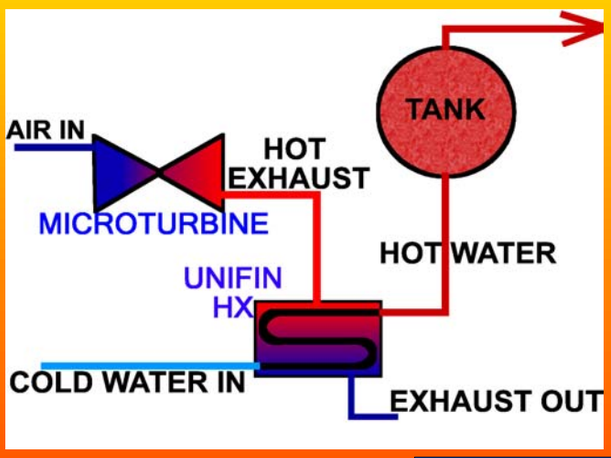
POSTERS CREATED BY DAVID VILLARROEL

Canada

Minto Place Suite Hotel Microturbine Thermal Experience



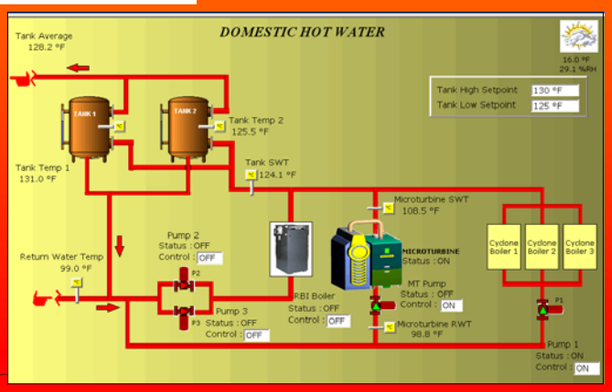


DHW use

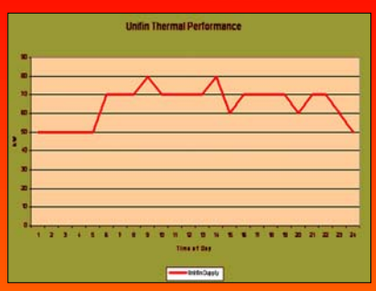
UNIFIN INFO

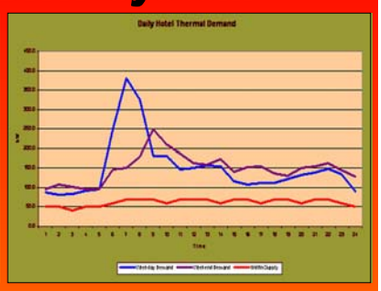
Max Thermal Output: 75 kW
Thermal Efficiency: 59 %
Co-generation Efficiency: 80 %

TEMP TABLE	INLET	OUTLET
WATER	16 - 55 C 60 - 131 F	23 - 57 C 73 - 134 F
FLUE GAS	288 C 550 F	25 - 60 C 77 - 140 F



Minto's DHW System



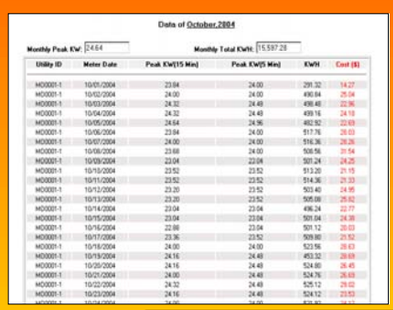


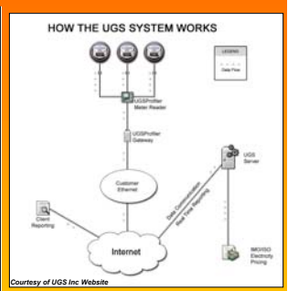
FLUE GAS CORROSION

THE INLET WATER TEMPERATURE ENTERING THE UNIFIN IS COLD AND THE OUTLET FLUE GAS TEMPERATURE IS LOW. WE CONSIDER THIS TO BE A POTENTIAL LONGTERM CORROSION HAZARD INSIDE THE HEAT EXCHANGER. AN ACID DEW POINT OF 30 C (87 F) (AMBIENT CONDITIONS OF 26 C (80 F) AND 50% RH) COULD BE REACHED LEADING TO CORROSION.

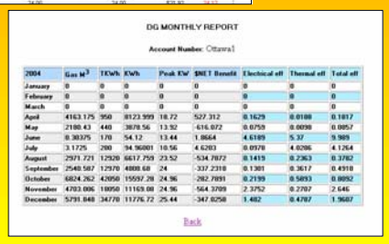
OUR SOLUTION WAS TO ADD A THREE WAY VALVE TO REGULATE THE TEMPERATURE OF THE INLET WATER TO 40 C (105 F) TO ELIMINATE ANY CONDENSATION. THIS REDUCES THE THERMAL EFFICIENCY BY 2 - 3 %, BUT SAVES REPLACING THE HEAT EXCHANGER.

UGS SCREENSHOTS

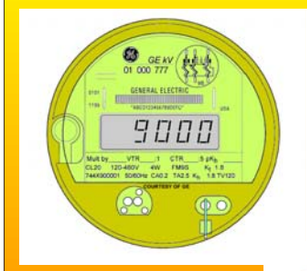


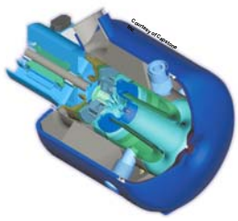


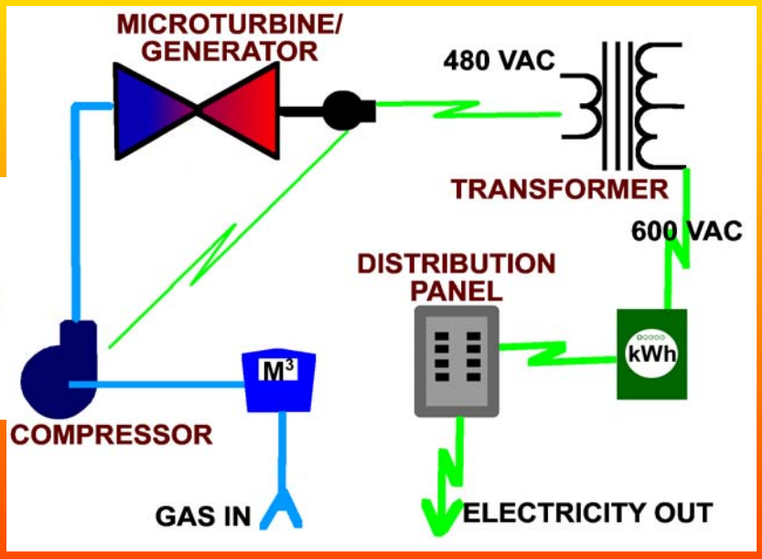
Courtesy of UGS Inc Website

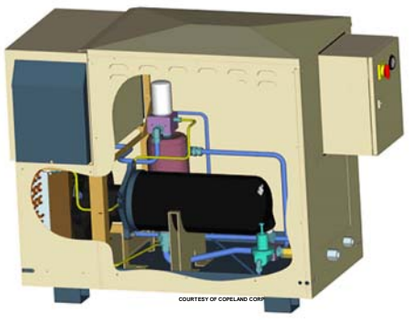


Minto Place Suite Hotel Microturbine Electrical Experience





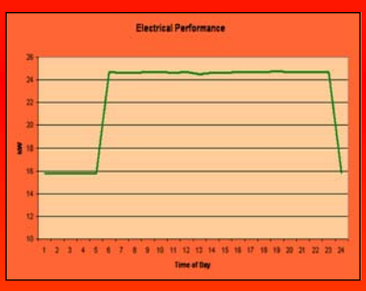


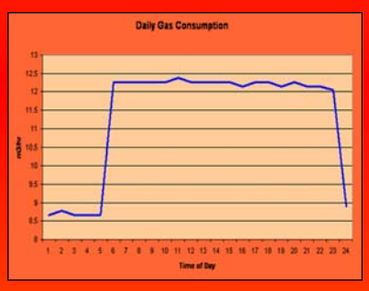


MICROTURBINE INFO

Capstone C30 Model
Max Output: 24.5 kWe
Efficiency: 20 %
Parasitic Losses:
- **Compressor: 3 kW**
- **Transformer: 0.5 kW**

Derating due to ambient air temp: 2 kW

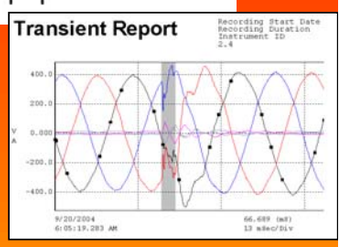




PHANTOM POWER (TRANSFORMER LOSSES)

EVER SINCE THE MICROTURBINE WAS INSTALLED, AN UNKNOWN ELECTRICAL LOAD WAS PRESENT IN OUR RECORDINGS. THIS LOAD EVEN OCCURRED WHEN THE MACHINE WAS SHUT DOWN. A READING OF 0.16 kW AT NO LOAD AND 0.51 kW AT FULL LOAD WAS MEASURED. THESE WERE THE LOSSES OF THE TRANSFORMER.

Utility Capacitor Switching Transients



HYDRO OTTAWA'S CAPACITOR SWITCHING OCCURS AROUND 5 - 6 AM EVERYDAY, SENDING A TRANSIENT THROUGHOUT ITS NETWORK. MOST OF THE TIME THE MICROTURBINE'S INTERNAL SOFTWARE, AFTER BEING ADJUSTED, CATCHES AND CORRECTS THE TRANSIENT, THOUGH IT STILL TRIPS APPROXIMATELY 1 - 2 TIMES PER WEEK. THE FAULT CODES DISPLAY SSL 4 - 6 INDICATING A GRID FAULT, THUS CAUSING A SHUT DOWN OF THE MICROTURBINE. TOO MANY SHUT DOWNS AND START-UPS CAUSE UNNECESSARY WEAR AND TEAR ON THE MACHINE.

THIS TRANSIENT PROBLEM CAN BE RESOLVED BY ADDING A CHOKE INDUCTANCE AT THE INPUT OF THE TRANSFORMER.

UGS SCREENSHOTS