PROPOSAL TO REDUCE POWER GENERATION COST AND DIESEL FUEL CONSUMPTION AT RACE ROCKS

The following recommendations and suggestions provide for a net reduction of the cost associated with the provision of power for the facilities at Race Rocks. The savings would result from reduced diesel fuel use. This has the added benefit of reducing the risk of a fuel spill at this site, which is an Ecological Reserve and Marine Protected Area.

It is anticipated that diesel generator operating costs will be reduced by 50 to 75 percent. This would result from the diesel generator operating at full load while charging a battery bank and then shutting down while the batteries supply power to inverters which in turn provide 60 cycle power for the island.

The size and cost of a battery/inverter system is sensitive to the load that must be served. In order to allow more accurate sizing of the system, minimize the capital cost of the system and reduce operating costs after the system is installed, the electrical load on the island should first be reduced and then be re-evaluated in terms of the reduced demand that would be placed on a battery/inverter system. There is great potential for such electrical load reduction or load management at Race Rocks.

As a result of my visit to Race Rocks on April 1st and 2nd I offer the following recommendations and suggestions. The figures I have given for Cost, Labour and Power Reduction are rough estimates, especially with regard to Labour. If you wish I can provide you with more detailed information that will assist you in selecting hardware and refining the estimates.

SHORT TERM RECOMMENDATIONS

LOAD MANAGEMENT

These recommendations are intended to reduce power consumption to 2kW overnight and 10kW during the day.

a) Consider installation of a propane system to replace the largest electrical loads in both houses. Install 3 propane tanks, each small enough that two such tanks can be carried in the boat where the diesel fuel transport tank presently fits, without subjecting the boat to any load greater than that presented by the existing diesel fuel transport tank. Larger propane tanks could be considered with the assistance of a marine engineer. One propane tank would remain on the island while two are off being filled.

   A rack would be needed for the three propane tanks. This rack would be located where the diesel fuel transport tank is presently stored. The diesel fuel transport tank would then be stored above the propane tanks. This will allow easy access to the propane and diesel tanks by use of the crane. Another pair of propane tanks may be needed depending on the size of tank used, rate of propane use, and willingness to fill tanks more than once per year.

   An intermediate pressure propane line would run to each house. Siting the line should be a manageable challenge with the assistance of a gas installer. (Propane heat could also replace the baseboard heaters in the desalinator room and engine room.) Allow $1000 each

for the tanks, $1000 for other hardware and 100 hours labour.

Propane service would allow replacement of the two electric stoves presently using 4000W each intermittently (10,250W max), the clothes dryer presently using 5000W intermittently, the two hot water tanks presently using 3000W each intermittently and the hot tub using 4000W intermittently. (This proposal assumes the baseboard heaters in the desalinator room and engine room are not being used.)

Propane appliances for consideration would be two stoves at $1000 each, one clothes dryer at $500 and two high efficiency boilers at $2,500 each. The boilers would be plumbed to provide heat for two domestic hot water tanks at $500 each and the hot tub at $500. (In the long term hot water from the boilers would also be used for forced air space heating when the oil furnaces need to be replaced.) (Consider retaining the existing domestic hot water tanks with the substitution of 1000W elements and feed water through a tempering valve from a small high water temperature heat exchanger tank.) Labour estimated at another 100 hours.

Using hot water from the propane fired boilers to heat the domestic hot water, hot tub and forced air furnaces will simplify future reductions in propane use with the substitution of heat from solar hot water, heat pump and diesel generator waste heat sources.
Cost- $13,000
Labour- 200 hours
Power Reduction- 23,000W intermittent

b) Measure the power consumption and output of the impeller pump supplying the touch tank and consider installing a piston pump to replace the impeller pump. Modify the belt drive on the piston pump and select a motor for appropriate power consumption and output. A piston pump will use less power, will be easier to prime and will be more reliable in use. Corrosion may be a problem that can be dealt with by buying a more expensive pump.
Cost- $500
Labour- 4 hours
Power reduction- 400W full time

c) Consider installing a second piston pump as a backup for the touch tank and to supply seawater for the desalinator.
Cost- $500
Labour- 2 hours
Power Reduction- minimal

d) Measure the power consumption of the composting toilets in the assistant keepers house and consider timers for the heating elements so that power consumption can be adjusted as needed.
Cost- $200
Labour- 4 hours
Power Reduction- 400W full time

e) Adjust the battery chargers for the diesel generator starting batteries. One is supplying 4 times the current of the other.
Cost- minimal

Labour- 1 hour
Power Reduction- 39W full time

f) Measure the power consumption of the generator room air supply fan and consider fitting a thermostat and diesel engine operation link so that this fan operates only when needed. While the generators are shut off and the inverters are supplying power this air supply will not be needed full time.
Cost- $200
Labour- 5 hours
Power Reduction- 500W full time

g) Consider shutting down the convection heaters in the lighthouse. Suggest to the Coast Guard that they repair or confirm correct operation of the solar powered ventilation fan. One of the convection heaters was operating normally and the other was blowing cold air when observed April 1st. Both are corroded and I suspect one has a defective heating element. They are normally capable of drawing 2000W each. (A more sophisticated analysis of the ventilation needs of the lighthouse can be done at a later date and should allow appropriate humidity control with little power use.)
Cost- minimal
Labour- 10 minutes
Power Reduction- 2000W full time

h) Consider replacing the incandescent and flourescent lights over the touch tank with a full spectrum or GroLite flourescent fixture.
Cost- $150
Labour- 1 hour
Power Reduction- 120W full time

i) Consider replacing the domestic water impeller pumps in each house with piston pumps. Modify the belt drive on the piston pumps and select a motor for appropriate output and power consumption. Consider replacing the small pressure tanks that rust out frequently with large corrosion proof pressure tanks. Cycle the pressure tanks between their maximum pressure and the lowest pressure that will serve a pressure regulator on the water lines to the shower. This will increase the duty cycle and reduce the power draw for the pressure pumps. Previous pump and tank replacement costs should be reduced.
Cost- $4000
Labour- 4 hours
Power reduction- 1000W intermittent

j) Measure the power consumption of the desalinator and consider rewiring the desalinator motor from 120V to 240V.
Cost- minimal
Labour- 2 hours
Power Reduction- 50W intermittent

k) Consider replacing the incandescent lights outdoors and in the assistant's house with compact flourescent lights. Different types of compact flourescents are needed depending on the fixture and location. In some cases it may be desirable to change the fixture. There are 34 fixtures and the lights cost between $10 and $25 each.

Cost- $700
Labour- 4 hours
Power Reduction- 1,600W intermittent

l) Following the above load management measures and using the resulting digital records of diesel generator output, re-evaluate power consumption in terms of the demand that would be placed on a battery/inverter system.

GENERATOR CONVERSION

This recommendation provides for the reduction of diesel fuel consumption and power generating cost.

Consider installing a battery/inverter system. The system could be designed and supplied by Mechron Power Systems in Ottawa or designed by Xantrex in Vancouver and supplied by SolTek Powersource or Energy Alternatives in Victoria.

Mechron is the supplier of the existing diesel generator system. Mechron has also designed and installed numerous generator/battery/inverter systems which they refer to as Hybrid Cycle Charge Systems. Xanterx has a narrower scope, providing the most popular line of sophisticated inverters. Mechron suggests that conversion to a generator/battery/inverter system can provide a 50% reduction in operating costs and Xantrex suggests that conversion to a generator/battery/inverter system can provide a 75% reduction in operating costs. I have a conversion cost estimate for the Xantrex system only.
Cost- $35,000
Labour- 100 hours
Generator Operating Cost Reduction- 50% (This should take the form of a near 50% reduction in diesel fuel use.)

The above load management and generator conversion costs add up to near $55,000 with near 325 hours labour needed for installation. They provide a power demand reduction of 3,459W full time and 25,600W intermittent. Assuming a capital costs of 5% and a 10 year amortization, a rough calculation suggests the above changes would yield a significant net reduction in the cost of providing power to Race Rocks.

Additional benefits of reduced diesel fuel consumption would be a reduced hazard from transport of diesel fuel and a system that is ready to utilize renewable sources of power such as solar, wind and tidal. Use of renewable power sources would directly lead to further reductions in diesel fuel and propane use. With the significant reduction of fossil fuel use in an Ecological Reserve and the high profile provided by the racerocks.com web site I anticipate that there would be a range of sources for funding.

MID TERM SUGGESTIONS

These suggestions offer opportunities to further reduce fuel costs after installation of the battery/inverter system.

a) Small wind turbines could be mounted at the top deck of the light house without affecting

the structure. This power would also be fed to the battery bank.

b) Solar heating of water can provide heat to the various buildings. This would require insulated hot and cold water pipes running between the buildings, creating a small district heating system. The hot water can be used for space heating, domestic hot water, clothes drying, the hot tub and the composting toilets.

c) The hot water district heating system can be powered by waste heat from the diesel generator, a water source heat pump and any other renewable or non-renewable source.

d) The cistern in the assistants house could be insulated and used to store hot water for the district heating system.

e) Highly insulated energy efficient chest freezers could replace the two conventional freezers.

f) Photovoltaic solar panels could replace the south facing roof surface on the assistants house. This power would be fed to the battery bank.

g) The air seal on one of the double wall diesel fuel tanks has failed. The relevant valves on both tanks are corroded. While not strictly related to power use, you may wish to replace the fittings and re-establish the vacuum.

LONG TERM SUGGESTIONS
These suggestions offer ideas that you may wish to consider in the future.

a) The oil furnaces could be converted with heat exchangers carrying hot water supplied by the propane fired boilers, solar collectors or district heating system.

b) A tidal turbine could be suspended from a barge moored in the channel east of Greater Race Island.

c) A greenhouse could be built on the concrete slab south of the keepers house. This would provide space for a vegetable garden for the caretakers, a marsh system that cleans rainwater collected from the roofs and a natural light location for the touch tank. The water tanks under the slab could be returned to the purpose of providing fresh water for gardening and other outdoor uses. With the integration of a marsh system in the greenhouse the water would be clean and fresh. This would be an improvement over the conditions that existed when the tanks were taken out of service. It may also prove to be a better source of water for the desalinator.

Please contact me if I can be of assistance in your consideration of these recommendations and suggestions.

Michael Wheatley
239 Richmond Avenue
Victoria, BC V8S 3X9
wheatley@pinc.com
250-592-6748