

## On the Hook ~ Cruise & Live

We thought about planning for a Live Aboard Life Style and it usually came down to the Use and Replenishment of Key Resources over some known periods of time. The parameters we set are:

- ❖ Expected Temperature, Humidity, Wind, Rain
- ❖ Normal Replenishment Period(s) in Days
- ❖ Fuel Use ~ Diesel and Propane
- ❖ Electrical Discharge & Charge Rate
- ❖ Potable Water Consumption & Replacement
- ❖ Fresh / Frozen / Canned Food ~ Storage & Purchase

Locations where we want to Cruise and spend extended periods become critical. We know people who spend Summers up in Greenland / Iceland and Winter in the Florida Keys. Others go to the BVI / USVI and stay for a year or so. Many people take January – April in the Caribbean.

1. We will do arithmetic for November to April in the Turks & Caicos.

While some people can Circumnavigate the Globe, most of us have lifestyle commitments that require contact with others. It is rare to go a week without meeting others and that often revolves around shopping, eating, playing or planning activities.

2. We set time between on-board time and trips to port at 5 days

Distances we would cover before and after Time on the Hook, and during the time of extended relatively stationary live aboard times are quite different. Travelling the East Coast is easy as Marina Services are abundant. Florida to Turks & Caicos can be 2-step sail or one that takes 30 days of short hops.

3. Ocean sailing 3days / 300 miles, Caribbean Cruising 1 day / 25 miles.

Electrical Balance of Charge ~ Discharge is very much a function of Lifestyle. Is Air-Conditioning required? Do we need a long warm shower everyday? Concerned about Global Warming and need to reduce a Carbon Footprint?

4. Maximize Wind / Solar and use Engine Alternator in Emergency

Food, Drink and Cleanliness come together for Quality of Life. Because we are on-board does not mean grow a beard, eat canned food and drink warm, but potable water. Refrigeration, Lighting, Freshly Brewed Coffee, Salad and some Hot Water are essential to us.

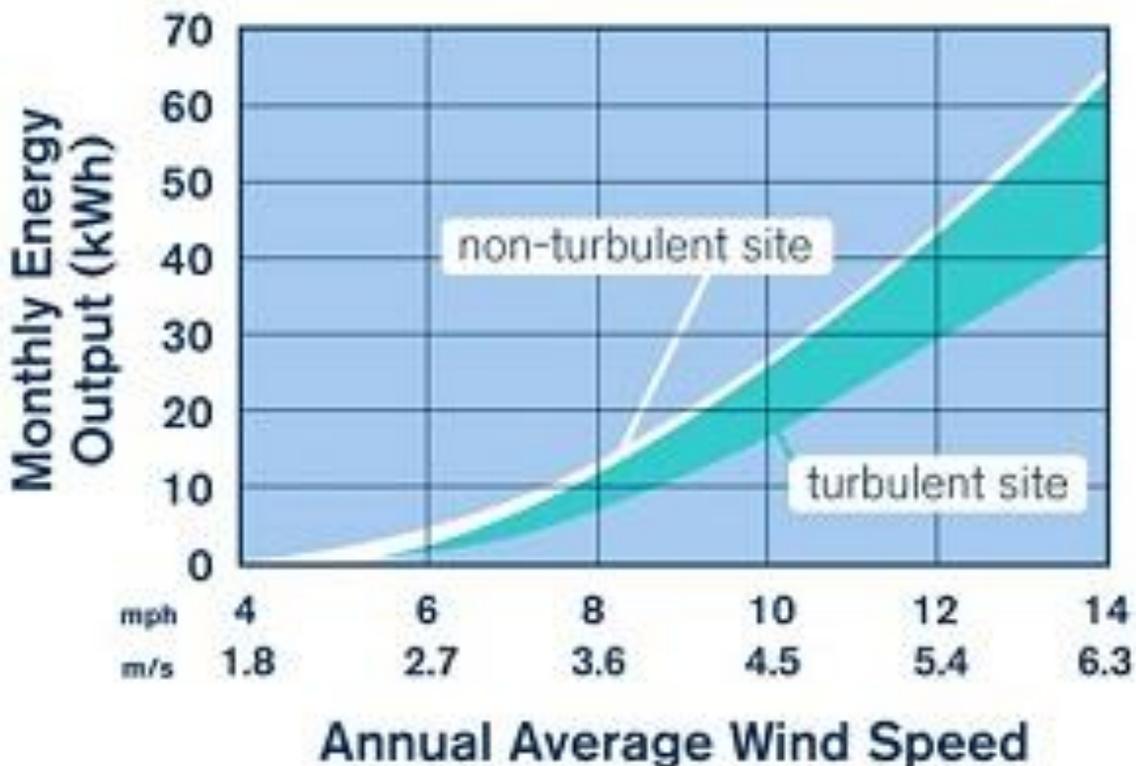
5. Take steps to maximize system efficiencies

## Solar Panel and Wind Generator Output Considerations

The efficiency of the solar cells used in photovoltaic systems, in combination with latitude and climate, determines the annual energy output of the system. For example, a solar panel with 20% efficiency and an area of 1 m<sup>2</sup> will produce 200 W at Standard Test Conditions, but it can produce more when the sun is high in the sky and will produce less in cloudy conditions or when the sun is low in the sky. With Insolation of 5.5 kWh/m<sup>2</sup>/day (230W/m<sup>2</sup>), a 200 W panel can be expected to produce 400 kWh of energy per year, or 1.1kWh/day. On a 12VDC system this represents 90Ah daily. Most MPPT charge controllers have an efficiency rating of 92-95% and with wiring and other electrical losses the expected output for design purposes should be 80Ah/day from 200 W solar panels at 12VDC.

A 300W Starter Kit is ideal quiet power production and grid independence. This kit comes with the tools necessary for a new system: three 100W 12V Monocrystalline Solar Panels, one 30A MPPT Charge Controller, one 20ft 10AWG MC4 Adaptor Kit, one 8ft 10AWG Tray Cable, two pairs of branch connectors, and three sets of Z-brackets. We could start our solar adventure with the convenience and comfort of knowing that we could have power anywhere there is sunlight! - \$540 then connecting to our pre-wire - \$80.

For a 400W wind generator the output curve below shows that at 14 mph



the expected output is about 50 kWh /month or 600 kWh / year at an average of 15 mph the output rises to 720 kWh /year, or 2.0 kWh/month, a 12VDC system this represents about 170 Ah daily. Most MPPT charge controllers have an efficiency rating of 92-95% and with wiring and other electrical losses the expected output for design purposes could be 150Ah / day at 12VDC. The problem is that at both ends of the wind speed range of under 8 mph and gusts of over 25 mph the wind generator does not produce or shuts down to prevent overload. The design point for the wind generator output is set at 70% of calculated. The wind generator is installed and has a built-in microprocessor charge controller.

Turks & Caicos	Ave High degF	Ave Low degF	Rainfall in/month
November	82	80	4.9
December	80	78	2.8
January	78	76	1.8
February	78	75	1.5
March	78	75	1.8
April	79	76	1.6

	Daylight Hrs	Solar Energy kWh/sqM	300 Watt Ah/day
November	11	4.4	108
December	10	4.2	103
January	10	4.6	113
February	11	5.5	135
March	11	6.4	157
April	12	6.8	167
Average Monthly			<b>131</b>

	Average Wind mph	Average Ah 400 W Generator	Design for 70% Wind Ah
November	15	170	119
December	16	190	133
January	15	170	119
February	15	170	119
March	15	170	119
April	14	150	105
Average Monthly	<b>15</b>	<b>170</b>	<b>119</b>

Combined		
Monthly	Ah/day	250
Monthly Range	Ah/day	227 -> 276

We now have some important Wind and Solar energy generation that we can expect from a 400W wind generator and 300W of solar panels when moored in the Turks and Caicos Islands between November and April. We need to see how the daily recharge rate of 250Ah will be consumed by examining a ranking of the 12VDC and 120VAC inverter loads on board.

Equipment	Amperage	Hours / Day	Total Ah	Cumulative Ah
Refrigeration	5	12.0	60	60
NavLights - LED	3 * .67	10.0	20	80
Cabin Lights	4 * 1.5	6.0	36	116
VHF / HF Comms	2	2.0	4	120
Bilge/Water Pumps	3 * 7	1.0	21	141
ElectroSan ~ waste	2 * 15	0.5	15	156
Microwave / Coffee	2 * 7	1.0	15	165
Computers	2 * 1	8.0	16	181
TV / Music	3 * 1	6	18	199
Water maker	18	3	48	247
Inverter ~ AC Fans	2 * 3	6	36	293

A study of the table shows quickly that some things like warm water, showers, crock pots ... have never hit the list. The energy balance while swinging on the hook never lets the battery get drained down past 50% because tomorrow may have no wind and be overcast. We look after Food, Waste, Water and Communications and even under poor circumstances everyone is fit and healthy.

WHY – because if we keep a reserve of 20 gallons of water (in jerry-cans on deck), two people will survive for 7 days. If our battery power never goes under 50% and we never use more than half of available fuel, we can diesel at least 200 miles. We would have at least 32 cans of "Pork & Beans" and stay good for 8 days. We have power to run Navigation and Comms and get back safely.

Now if we want to live the same as we do on-shore... The Air conditioning will use 25,000BTU and the water use will go to 40 gallons /day for us as a

couple. The AC takes 25A/120 VAC or 300A at 12v DC, you can run the AC for only 3 hours before needing to recharge. The water maker takes 18A at 12VDC, producing 4gal/hr., this takes 72Ahr. The answer would be to put a 4kW GenSet on board - \$5,000 to buy and install. With a GenSet we could run the boat like a condo, but the fuel use could be 5 gallons/day diesel. It would be appropriate to add another 75-gallon diesel tank to the boat – another \$8,000.

We have gone through these calculations and come up with Wind/Solar NO GenSet and call a halt at TV/Music. We are not true live-aboard, but can see, in a suitable Climate, like the Turks & Caicos it is quite do-able. Now we needed to consider living spaces, how to tender to ports, cooking proper meals, cleaning ourselves and our clothes thoroughly.

## **Lifestyle & Security**

### **LPG Pudgy, Ports ~ Electric vs Outboard**

When moored the design plan is to provision on a 5 to 7-day basis using the tender. The Portland Pudgy has a 4 HP equivalent electric seawater drive motor (12V 32Ah Li-Ion battery weight 10#) and a 5HP Lehr LPG outboard, envisioned for use on longer trips to shore / dive locations. The electric drive is a delight to use as it is silent and exhaust free. For extensive use of the dingy the SS lift bar and rods would be removed and replaced with 4 eye bolts for front/rear rope lifting slings. The steel bar is very secure for transit in up to hurricane winds, but more awkward for daily tender use while on the hook.

### **Cooking, BBQ, Freezer, Microwave and Hot Water**

The 3 LPG tanks in the LPG locker for the galley stove will support stove top drink / simple meal preparation daily for 30-45 days. The LPG tanks are 10# size and require refilling on-shore. We do not plan to use the oven as it does not appear to be very efficient. Our planning was to be able to use the Crockpot / Keurig / Microwave via the inverter as more energy efficient food preparation from Cans/De-hydrated Pouches/Bottled Water/ Microwave-Ready food products. These 3 have power ratings of 1200W / 600W / 800W respectively. How much we use them is dependent on battery state of charge as they are less than a 50% load on the 2300W inverter. The BBQ has brackets for rail mount and uses 2# LPG bottles. These are easy to store 10+ in the LPG locker. The same 2# bottles are used on the Lehr Outboard

engine. We have considered using the Salon table moveable seat interior storage for an additional 8 – 10 LPG 2# propane bottles. Hot water on board can be derived two ways. Run 120VAC for the Water Heater using Shore Power or Inverter for about 10 minutes gives enough for washing dishes, hair or shaving. Alternatively, start the engine for engine heat exchanger hot water for 15 minutes +/- to get 3 or 4 gallons. An engine start a couple of times a week is very sensible and does not need to run above idle.

### **Seating spaces – Center Cockpit, Adirondacks, Salon ...**

When we sailed our 31' Hunter we decided that the next boat would have multiple places to sit, read, relax and socialize. Adirondack chairs are very comfortable but quite expansive. We downscaled a pair of them for the AFT deck behind the Mizzen mast and built out the area with a table and the BBQ within arms-reach. The cockpit is very spacious, and the addition of folding seat & backs allow hours of comfort in the shade, out of the sun. The Salon oval table did not have seating on the side opposite the curved bench, so we designed and built a sliding bench so the table can be used from both sides easily. The 3 spaces fit our strategy of "In the Sun, In the Shade and Out of the Weather seating". To complement the cockpit seating, we used side screens for the enclosure that fully roll to the roof, allowing cross ventilation of 8' width both sides. This seating plan we feel has done well to cover periods of Rain, High Humidity, Sunshine and Scorching Temperatures.

### **Lighting**

It is surprising how much power lighting can consume. In the refit LED Navigation Lighting was installed. All the Main Cabin, Galley, Midship and AFT dressing/head lighting is compact fluorescent with dual switch to Red for night vision support. In the cockpit we have a LED strip along the enclosure ridge beam which fully lights the whole cockpit enough for reading, while only using less than 1.0 Ah. When we added up our expected lighting load it is in the vicinity of 60Ah. The AFT and V berth lighting remains incandescent without any plan to change them as their usage is rarely more than a few minutes.

### **XM satellite, Music, Communications**

We planned and installed all on-board communication and entertainment using 12VDC equipment – TV, SW/MW/LW Radio, XM Satellite, Server PC. For Laptop PC's and Tablets, we connect a small inverter to the auxiliary 12V forward battery bank for dedicated recharging of those products. The trend to larger 8700 mAh laptop batteries indicate that very high usage up to 12+

hours per day will use about 16Ah of the 180 Ah auxiliary battery capacity. Both groups are shown in the table above and supported by Wind / Solar.

### **Midship Berth or Work Center/Food Storage/Bottled Water**

As we progressed on the multi-year refit of Rua Fiola we used the midship berth location as a workroom / workshop. In a live-aboard boat it would return to that configuration, with fitted plastic crates for both food, soft goods, office and consumable parts storage. We set it up with a vice, battery powered hand tools and charging station. This left the Nav Station and Salon table, free for office type work with computers and paper.

### **How to use ElectroSans – Solid/Liquid Human Waste**

In the refit we added a second holding tank tied to the FWD head. Both AFT and FWD heads have ElectroSans, Y valve and 12VDC diaphragm holding tank discharge pumps. On the hook the AFT head is exclusive for solid waste and the FWD head for urine. ElectroSan cycles on the holding tanks break down the waste. The revised Marine Pollution Regulations, state that Type B sewage treatment systems, such as the Lectra/San® system, can discharge treated sewage anywhere except within 500 meters of a marine farm or maitaitai reserve. To optimally use our ElectroSans we would use twice the seawater flush (2 bowls) on the AFT than the FWD head to ensure greater hydrochlorous acid generation for solid waste treatment.

### **Sailing Shorthanded – 2 in hurricane force winds 24 hours ...**

Much of the refit was predicated on 2-person shorthanded blue water sailing. We have done 250 miles offshore passage with winds as high as 60 knots for 12-hour+ duration. We never left the cockpit and maintained full control of the boat. This is why we think that if necessary, passages of up to 300 miles can be done by a couple over 3 days using Sail or Diesel as appropriate.

### **Reliability while at Anchor, Rockna & CQ + spare Danforth ...**

Rua Fiola came equipped when we bought her with a Rockna, CQ and rear mounted Danforth anchor. This was the configuration that we think was installed for her 2 year stay off Venezuela. While we have removed the Danforth and its mounting bracket, we would re-install it for Offshore and Cruising use. Similarly, there are 2 Dive Safety/Demarcation Floats on 8ft fiberglass poles that can be re-installed.

### **Essential Safety – Wood Bungs, Engine, EPIRB, Life raft ...**

Being out on the ocean, your own safety is paramount. The Portland Pudgy is a double hull vessel that is unsinkable. A full life raft enclosure can be

purchased for it. This, in our opinion, is good for 2 people in Caribbean waters. Were the number aboard to be greater than 2 or was sailing to be done in less travelled shipping areas we would probably re-install the 6-person Plastimo Life raft. We idled it because for use under emergency conditions as we felt we were unable to lift/unpack/inflate with only 2 older people. We have Tapered wood bungs/Mallet for closing up to 2" holes in the hull. A portable EPIRB in a cockpit coaming pocket, AIS transceiver, XM satellite weather, Radar and the VHF radios have DSC tied via the NMEA 2000 backbone to GPS with MMSI identification. While we carry a very full complement of hand tools and spares, we consider the 2 most important things for the engine are, a spare 90A alternator and a replacement starter motor. We have a hydraulic 10 Ton crimper, wire strippers, terminals and heavy gauge wire (#6, #4) to effect almost any power wiring repair while underway. Auxiliary circuit wiring repair of #12 to #16 is also covered. A large 3ft long bolt cutter is in the anchor locker should it become necessary to cut the chain anchor rhode in an emergency.

### **Costs & Outstanding Work List**

Wind /Solar Charging & Control \$620

Prewire to the house batteries is in place. As is the 400W mizzen mast wind generator. Add 2 x 150W roof mounted solar panels and connect through 2 x 30A Coaming Mounted MPPT charge controllers to the Blue Seas power center in the engine compartment. Include Watthour LCD panels to the teak mounting for the charge controller that show the House and Auxiliary battery charge and use balances.

Main Salon Charging Center \$200

Fit a dedicated 150W pure sine wave inverter to the auxiliary battery / fuse hub and connect to the existing 120VAC receptacle on the salon bulkhead.

Lehr 5HP LPG Propane Outboard Lift / Mount \$400

Purchase a Hydraulic Arm / 360° Swivel 500# Lift Unit and an adjustable outboard motor railing mount, so that the Lehr can be safely and securely transferred to and from the boat to the tender.