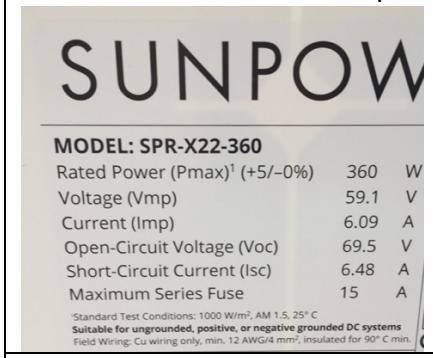
Objectives

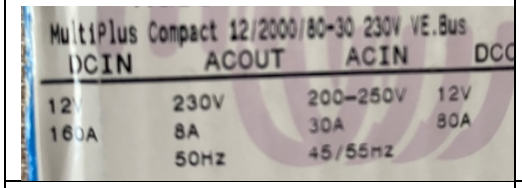
- Replace aging AGM batteries
- Prefer batteries to primarily be charged from clean energy (ie solar) with incidental charging from engines at the start and the end of the day, if we are on the move, motoring and/or sailing.
- Increase battery power / inverter load (and make wiring changes) to give the option to run Watermaker and Washing Machine without generator (see below) – does not need to be simultaneously and can be in the middle of the day to allow time for solar to replace used power
- Do not want to have excessive battery capacity such that regular use of the generator is required to keep them at a reasonable SOC. Using genset to top up batteries should be the rare exception (eg winter, a few days of poor sunlight/weather at anchor, guests on board, lots of washing etc)
- Reliability and ongoing support is important due to the remoteness of our cruising grounds in Caribbean and Pacific (ie reputation and after sales support as well as ease of management for the "layperson". Needs to be stress free)
- Protection of our investment in the batteries is also paramount – temperature, overcharging etc

Cruising pattern:

- Full time living aboard
- Minimal use of marinas, mostly anchoring out. If using Marinas, we rarely connect to (dirty) shore power, and if we do its not to charge the batteries but to do washing on the high load circuit.
- Crossing the Atlantic in November, 6 months in Caribbean, 2-3 years in Pacific. Thus expecting good conditions for solar power generation.
- Gas for cooking except 700W kettle (used 3 x per day) and 1300W small toaster used. Also have 1300W electric frypan in case we run out of gas…

Current thoughts on requirements

System Element	Changes	Pros/Cons/Risks/comments
Solar Power 3 x SPR-X22 360W wired in parallel  SUNPOW MODEL: SPR-X22-360 Rated Power (Pmax)[1] (+5/–0%) 360 W Voltage (Vmp) 59.1 V Current (Imp) 6.09 A Open-Circuit Voltage (Voc) 69.5 V Short-Circuit Current (Isc) 6.48 A Maximum Series Fuse 15 A [1]Standard Test Conditions: 1000 W/m², AM 1.5, 25° C Suitable for ungrounded, positive, or negative grounded DC systems Field Wiring: Cu wiring only, min. 12 AWG/4 mm², insulated for 90° C min.	No change required	Typical day sailing will see us feed in 3.5-4.8kWh. That meets the demands of the autopilot and house systems, device charging and will see us through overnight. Additional demand/draw during the day to use for watermaker/washing machine could be replaced by further input from panels (??), dependant on conditions.
MPPT / Solar control Victron 150/70 x 1	No Change required	We did not have the wiring space to run 3 of these to the engine room. Don't see sufficient advantage in adding further units. 3 panels are wired in parallel.
Genset Northern Lights 4.5kVA 50Hz	No Change required	Currently used to run the watermaker & washing machine, usually simultaneously in order to ensure sufficient load. If only one is running we might turn on A/C to add load. Excess can feed into the batteries (20A current limit) if needed but we have not used it as a primary charging source for the batteries since we got solar panels. Concerns for its own battery health if we use it less (it only charges its own batteries).

System Element	Changes	Pros/Cons/Risks/comments
Inverter / Charger Victron 2000W  	Upgrade to Victron 3000W (120A)	Considered adding a 3KW inverter to run in parallel with our existing 2K one but that raises space issues. 3KW is sufficient to run the high load appliances so Quattro is probably not required.
Starter batteries Port 90Ah AGM – 75% health Starboard 150Ah AGM – 100% health	Replace port starter with service #2? Isolate starter batteries from house batteries.	Starboard starter battery is currently part of house bank. Need to test health of all batteries and exchange as necessary Keep 1 x AMG as a "spare"
Service Batteries Currently 5 x 150AH AGMs (formerly 6, Stb starter forms part of housebank) 1, 4 & 5 have SOH in 70% range Service #3 – removed Service #2 has SOH 85%	Test all batteries health and exchange with starters as required.	Previously 450Ah of usable power AGMs (ie 900Ah x 50%) Typically down from 100% to 80% SOC overnight Not currently needing to top them up with Genset, but incidental use of engine and genset during the day would contribute
Temperature protection for batteries Currently AGMs are in Stb engine bay, not sure of exact temperatures but it does get pretty hot with the engine running. Now heading into the tropics so have concerns	If Engine Bay: Active fan/blower installed to put cool air from outside over batteries If Stb bunk: Installation under STB bunk ensure sufficient air space around them	Lithiums need some airflow, but cooler temperatures are important. Space under bunk is large and close to the Stb engine bay. Inverter backs onto the rear of the cabin reducing the cable length (and voltage drop)

System Element	Changes	Pros/Cons/Risks/comments
Alternator protection / Overcharging - Hitachi 115A	Option 1: Install smart alternator regulators Option 2: DC-DC charger from alternators to service bank. Isolate starter batteries from house	Cheapest and simplest if the solution is plug and play ie compatible with current alternators, no modifications to alternators required) Need 4 x units so more expensive but next best solution if option #1 not possible
System monitors Currently: • Victron BMV 712 Smart • Blue Tooth App for MPPT/Solar	MG Master LV to monitor DC charge into and out of batteries Victron Cerbo GX integrated monitor and Touch 50 display	Victron BMV 712 repurposed to monitor both starter batteries

Appliance usage and key changes

Appliance	Current usage	Changes	Comments
Washing Machine	Bosch front loader Nominal power: 2000-2300W; 10A Heating of water and spin cycle presumably are times of peak load Typical cycle 0.85kWh Runs on high load circuit (Shore or generator) Typical usage: is 2-3 loads per week	We want to be able run this on batteries / inverter	Want to retain the option to run it directly on shore/genset (with inverter off) if possible.
Watermaker	Rainman 240V / 1250W / 6Amps Currently runs on high load circuit (generator) Typical usage: 1-2hrs at a time, 2-3 times per week	Want to be able to run this on the batteries if needed. It would be during the day and whilst underway (sailing or motoring) Need some wiring changes as currently doubles with the washing machine in the only high load power point	Want to retain the option to run it directly on genset (with inverter off) if possible.
Hot water	Currently heated by Port engine (v efficient), genset (not very efficient) and shore (ok) - 40L tank, possibly 700W	Would like the option to heat water from batteries/solar, but it would be a low priority in terms of access to “spare” power so probably a “manually” controllable switchover or set to trigger only in optimal conditions	
General wiring changes		- Additional power outlet in the cockpit behind the aft facing seat. - Power outlet in the stb deck locker where the genset and watermaker are located	

Appliance	Current usage	Changes	Comments
- Fridges and Freezer	2-300W DC power when compressors are running	Have added an extra cooling fan to the freezer which will turn on when compressor is running	Biggest “passive” energy draw on the boat, running all the time
- Air Con	Dometech Cruisair - Not sure of the BTUs & specs - Saloon and Stb cabin only - Runs on high load circuit (Shore /genset)	Rarely used. Do not feel the need to be able to run this on the batteries	
- Autopilot	Use it constantly when underway	No change. Overnight for long crossings, along with nav lights, will be an additional draw	Not a huge imposition, but critical to keep powered
- Radar	Garmin system, we rarely use it but expect to need it more in coming times		Not a huge imposition