ALEX LLOYD
MARINE SURVEYOR & ENGINEER

VESSEL INSPECTION COMMISSIONED BY:

Richard and Natalie Bartlett

Photograph 1 – Solar 6 on the River Great Ouse.

NAME OF VESSEL:

Solar 6

NAME OF SURVEYOR:

Alex Lloyd

GEOGRAPHICAL LOCATION OF SURVEY:

Buckden Marina, Mill Road, St Neots, PE19 5BH

DATE:

17/03/2022

ALEX LLOYD MARINE SURVEYOR
EMAIL: ALEX@ALEXLLOYDMARINESURVEYOR.COM
WEBSITE: WWW.ALEXLLOYDMARINESURVEYOR.COM
TELEPHONE: 07887802746 / 01480 384560

CONTENTS

1.0. INTRODUCTION

1.1. Surveyor

Alex Lloyd

1.2. Client

Richard and Natalie Bartlett

(Liability for the report is solely to the instructing client and to no other third party unless otherwise specified and agreed in writing beforehand).

1.3. Scope of Survey

The survey was commissioned to identity the vessels build quality, along with operation, practicality, and effectiveness of the vessels systems.

Details of any items that have been tested will be found in the text.

1.4. Location

Buckden Marina, Mill Road, St Neots, PE19 5BH.

1.5. Access

Gained by means of a floating pontoon.

1.6. Opening Up

There was no request made for opening up. The surveyor only removed unfixed panels/floorboards during the survey process.

Access to all items below inner floor level were limited to the confines of the bilge covering access panels.

Access to all items within the spaces between the ply lining and steel work covered with spray foam, was limited to the confines of the removable covering panels.

2.0. VESSELS DETAILS

2.1. **Name**: Solar 6

2.2. **Type**: Widebeam

2.3. **Year of Build**: 2021

2.4. **LOA**: 19.3 meters (owner reports)

2.5. **Engine Model**: 2 x 10kW Lynch Electric Motors

2.6. **Gearbox Model**: N/A

3.0. SURVEY LIMITATIONS

Where fixed panels, furniture and internal mouldings restrict access, areas were inspected through limited openings.

Access to the vessels hull was restricted due to the application of twin pack paint below the waterline. No comments have been made for the external condition of the underwater sections.

The vessel was surveyed in the water.

4.0. SURVEY REPORT

4.1. Construction Of Steel Work

According to the vessel's manual, the vessels steel shell was manufactured by Aquarius Canal Boat Builders Ltd of 17 Malt Street, Liverpool. The condition of the vessels steel shell is not covered in this survey.

At the time of inspection, the vessel was installed with three mooring points (strong points). Vessels above 18 meters should be installed with a least six strong points for mooring, anchoring, and tugging. Two at the bow, two at the stern, one port and one starboard. (ISO Code of Practice. 2003. *ISO 15084:2003 Small craft — Anchoring, mooring and towing — Strong points*. [online] Available at: <https://www.iso.org/standard/26407.html> [Accessed 29 April 2022].)

4.2. Electrical Propulsion System Overview

At the time of inspection, the vessel was equipped with two 10kW Lynch electric motors (Lynch Swordfish System) controlled by master and slave speed controllers. The 48-volt system is supplied by a 2000-amp hour battery pack, comprising of two banks of twenty-four, 2-volt cells, primarily designed to power electric forklift trucks.

4.3. Motor Controller Mounting Arrangements

According to the manufacturer's installation instructions, the motor controllers should be secured to the vessel via the four clearance holes provided. At the time

of inspection, no mechanical fastening on either motor controller was in place. The controllers were found adhered to the vessel using an unknown adhesive/sealant, only on one edge of both controllers. The back end of both controllers was able to be lifted by hand with minimal force. Please see Section 4 of the Sigmadrive PM Traction Technical Manual (Lynchmotors.co.uk. 2008. *Sigmadrive PM Traction Technical Manual SK79649-01*. [online] Available at: <https://www.lynchmotors.co.uk/pdfs/sigma-controllers-manual.pdf> [Accessed 12 April 2022].).

4.4. Cable Sizing

According to the manufacturer's installation instructions, the large frame sized motor controllers found at the time of inspection should be installed with a minimum of 70mm2 cable between the controller and motor, as well as the controller and battery pack.

Both speed controllers were found connected to the battery pack using a mixture of non-continuous 35mm2 and 50mm2 runs of cable. It is likely that the installer used off-cuts of different sized cable to make the connections.

4.5. Cable Termination

As per the manufacture's installation instructions, 'good quality crimping is essential in ensuring the long-term reliability of the vehicles electrical system'. Please see Sigmadrive PM Traction Technical Manual (Lynchmotors.co.uk. 2008. *Sigmadrive PM Traction Technical Manual SK79649-01*. [online] Available at:

<https://www.lynchmotors.co.uk/pdfs/sigma-controllers-manual.pdf> [Accessed 12 April 2022].).

To provide the best connections possible, it is vital that the correct sized terminals are used with the correct sized wire. It is also vital that the correct tooling is used to crimp the terminal onto the cable.

At the time of inspection, many of the connections between the copper tube terminals and cable were found inadequately made. The tooling marks on the crimps show that incorrect tooling had been used. Connections, including the battery cut off switch connection, were found with the incorrectly sized terminals attached to incorrectly sized cable.

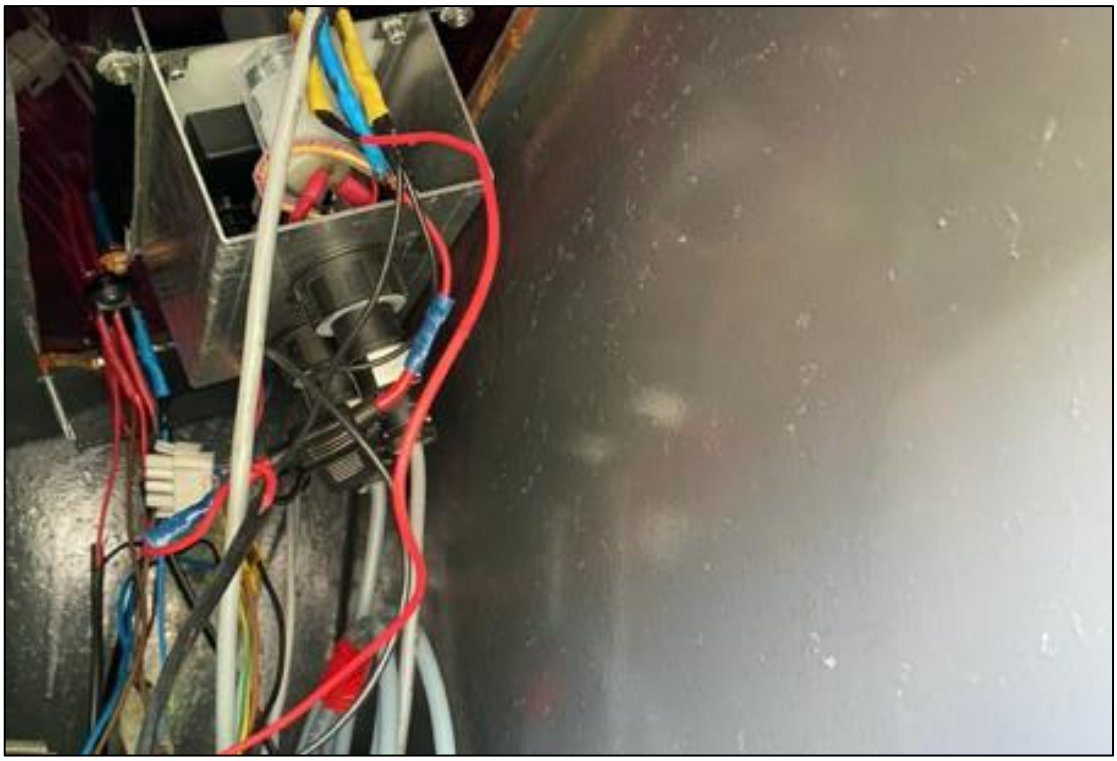
Incorrectly sized copper tube cable butt connectors were found joining unmatched/differently sized cables. Butt connections had been made using the incorrect tooling.

4.6. Cable Routing

At the time of inspection, much of the cabling was found unprotected and unsecure. Cabling should be clipped and sheathed to protect the cables from chafing overtime. Best practice would have the cabling protected in plastic trunking and secured every 30cms (ISO, 2012. *Small craft — Electrical systems — Extra-low-voltage d.c. installations*. 3rd ed. Geneva, Switzerland: International standard ISO 10133).

Cabling runs to the digital display and speed control binnacle and is routed through metal openings without sheathing.

Information regarding cable routing can also be found within the motor manufacturer's installation guide.



Photograph 2 – Unsupported and unprotected wiring under dashboard.

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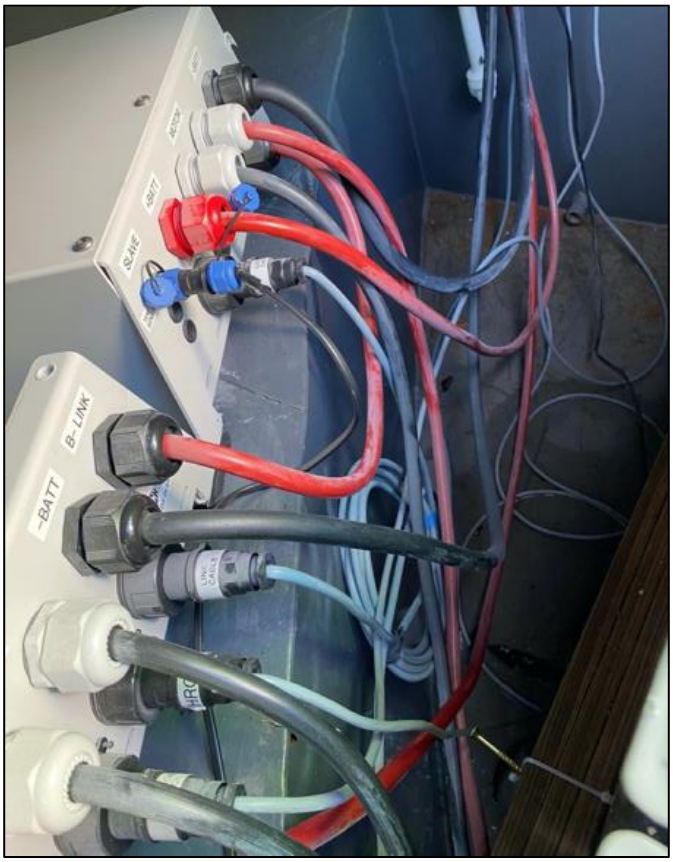

Photograph 3 – Unsupported and unprotected cabling from and to the motor controllers,

4.7. Battery Installation

At the time of inspection, twenty-four 2-volt batteries were installed in the engine space of the vessel. Batteries are installed directly onto the metal soul plate and inadequately secured using a single ratchet strap. Load from the ratchet strap was spread using lengths of timber.

The single ratchet strap is considered inadequate. Batteries should be installed in a manner to restrict their movement horizontally and vertically considering the intended use of craft, including trailering, craning and movement by road. A battery as installed shall not move more than 10mm in any direction when exposed to a

force corresponding to twice the battery weight. With light force applied, the individual batteries show signs of movement beyond the 10mm recommendation. Guidance on battery storage and securing arrangements is detailed within the following literature:

- Boatsafetyscheme.org. 2012. *BSS Examination Checking Procedures – Part 3 - Electrical systems Recommendations for change May 2012*. [online] Available at: <https://www.boatsafetyscheme.org/media/164563/ecp%20review%20-%20ecp%20changes%20part%203.pdf> [Accessed 12 April 2022].
- ISO, 2012. *Small craft — Electrical systems — Extra-low-voltage d.c. installations*. 3rd ed. Geneva, Switzerland: International standard ISO 10133.

The British Marine Federation states in their British Marine Federation Electrics and Electronics Association Code of Practice (5th Edition); 'Batteries should be stored in a dry location above the anticipated bilge water level. It is recommended that batteries are installed within an appropriate box or tray to catch any acid in the event of a cracked/damaged battery case. The corrosive battery acid would overtime impact/compromise the steel soul plate.'
(Marine, B., 2015. *Technical Support - BMEEA Code of Practice*. [online] Britishmarine.co.uk. Available at: <https://britishmarine.co.uk/Services/Business-Support/Technical-Support/BMEEA-Code-of-Practice> [Accessed 31 March 2022]).

At the time of inspection, the battery pack included permanently installed battery ventilation pipework venting overboard.

Although the vessels manual states that the batteries are Excide Industries 6pzs 840, the batteries are labelled '61PZS'. It is understood that these batteries are intended for use within forklift trucks. The suitability of this battery pack for running the vessels propulsion system and twin invertor arrangement is currently unknown. Supporting documentation/battery specification including charging parameters should be sighted and copied into the vessel's paperwork.

Photograph 4 – Current battery securing arrangement. Batteries installed directly on sole plate.

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4.8. Battery Shut Off Switches

Battery isolation switch location should be clearly marked from above deck level. (Boatsafetyscheme.org. 2012. *BSS Examination Checking Procedures – Part 3 - Electrical systems Recommendations for change May 2012*. [online] Available at: <https://www.boatsafetyscheme.org/media/164563/ecp%20review%20-%20ecp%20changes%20part%203.pdf> [Accessed 12 April 2022].)

At the time of inspection, the vessels electrical propulsion system was installed with two battery switches marked 'A701'. No other manufacturers identification could be found.

Upon further investigation, the two A701 battery switches found on the vessel at the time of inspection, appear to be a Chinese copy of the widely used BEP Marine 701 Contour battery master switch. It should be understood that the genuine BEP 701 master battery switch is continuously rated at 275-amps whereas the A701 battery switch is continuously rated at 200-amps.

A 200-amp continuous rating A701 battery switch is underrated to supply the battery control motors at full capacity. If the boat builder has supporting documents to prove the rating of the battery switches this should be sighted and copied into the vessel's paperwork/build specification. One 10kW motor has the potential to draw approximately 208.33-amps at 48-volts and (taking discharge into account) 222-amps at 45-volts.

Photograph 5 – Cable end crimped using improper tooling.

Photograph 6 – Cable end crimped using improper tooling.

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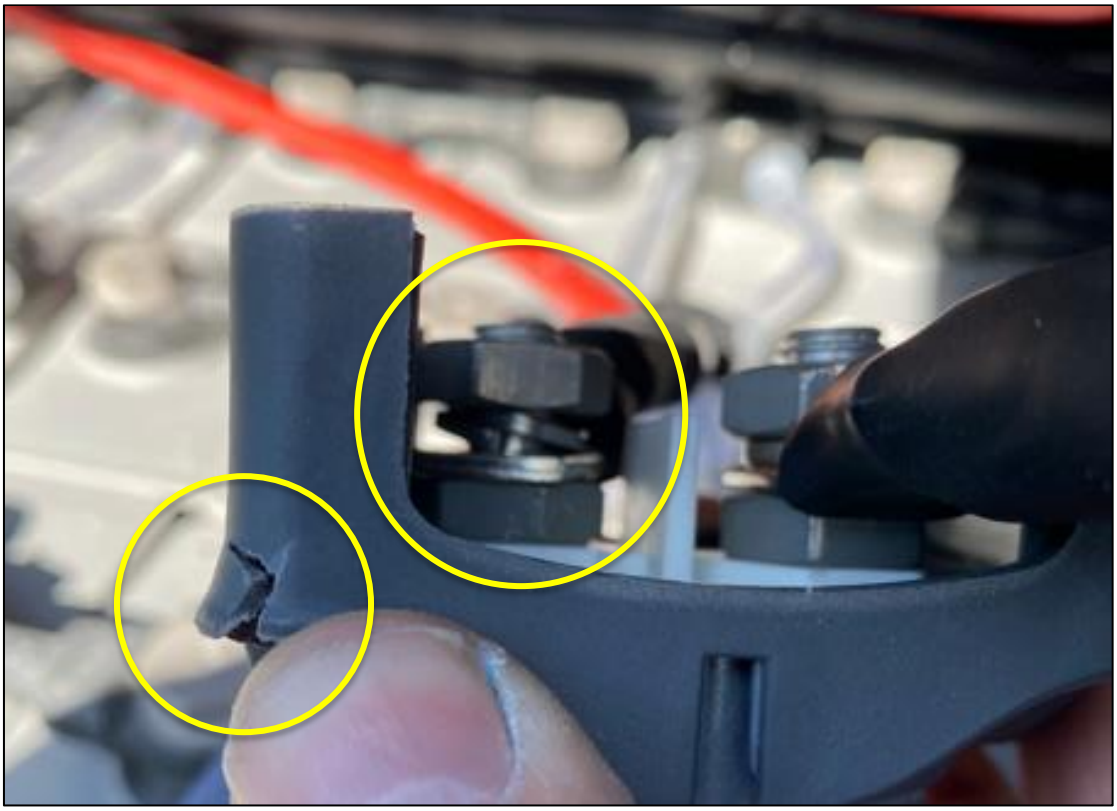


Photograph 7 – Loose termination on battery switch and battery switch housing cracked.

5.0. ELECTRICAL SYSTEMS

5.1. Inverters

At the time of inspection, the vessel was found equipped with two unbranded 5KVA inverter/charger/solar controller combinations. Further research shows the combination units are marketed and manufactured by a company called Voltronic Power. According to the company's website, they are based at 406 Xiwau, 1st St Road, Neihu District, Taipei, Taiwan. At the time of writing, no C.E. marking or similar supporting documentation can be found within the vessel's documentation or the Voltronic website (www.votronic.co.uk). It is unclear whether the inverters

are fit for marine purpose or are legal under British/European standards. Contact the boat builder for supporting documentation.

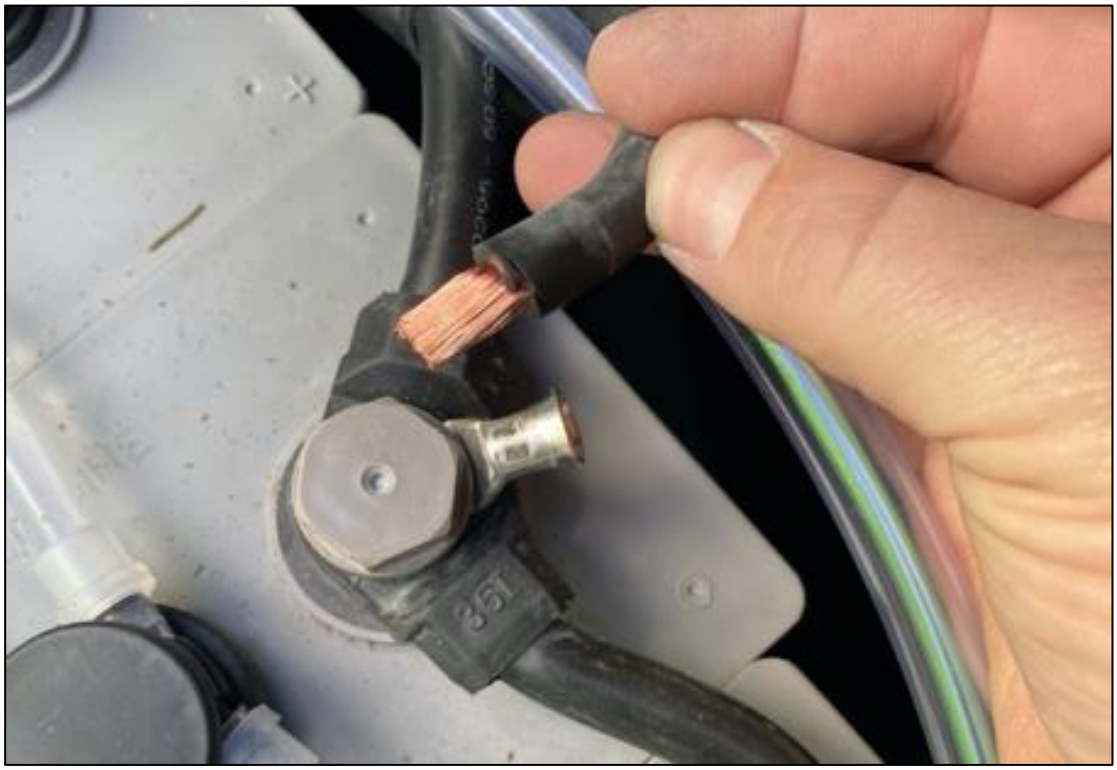
5.1.1. Inverter Cable Sizing

At the time of inspection, both inverters were supplied by a single 35mm2 cable though a A702 switch (believed to be rated at 200-amps). The approximate amp rating for good quality 35mm2 cable is 240-amps. According to the manufactures installation manual the maximum amperage of a single inverter is 137-amps meaning the cable could be drawing 274-amps meaning the battery cable and battery switch are underrated.

Furthermore, the battery switches are mounted using incorrectly sized self-drilling machine screws. Only two of the four mounting points have been used. The outer casing of the battery switches has been damaged due to the oversized machine screw heads.

At the time of inspection, many of the connections between the copper tube terminals and cable were found inadequately made. The tooling marks on the crimps show that incorrect tooling had been used. Connections, including the battery cut off switch connection, were found with the incorrectly sized terminals attached to incorrectly sized cable.

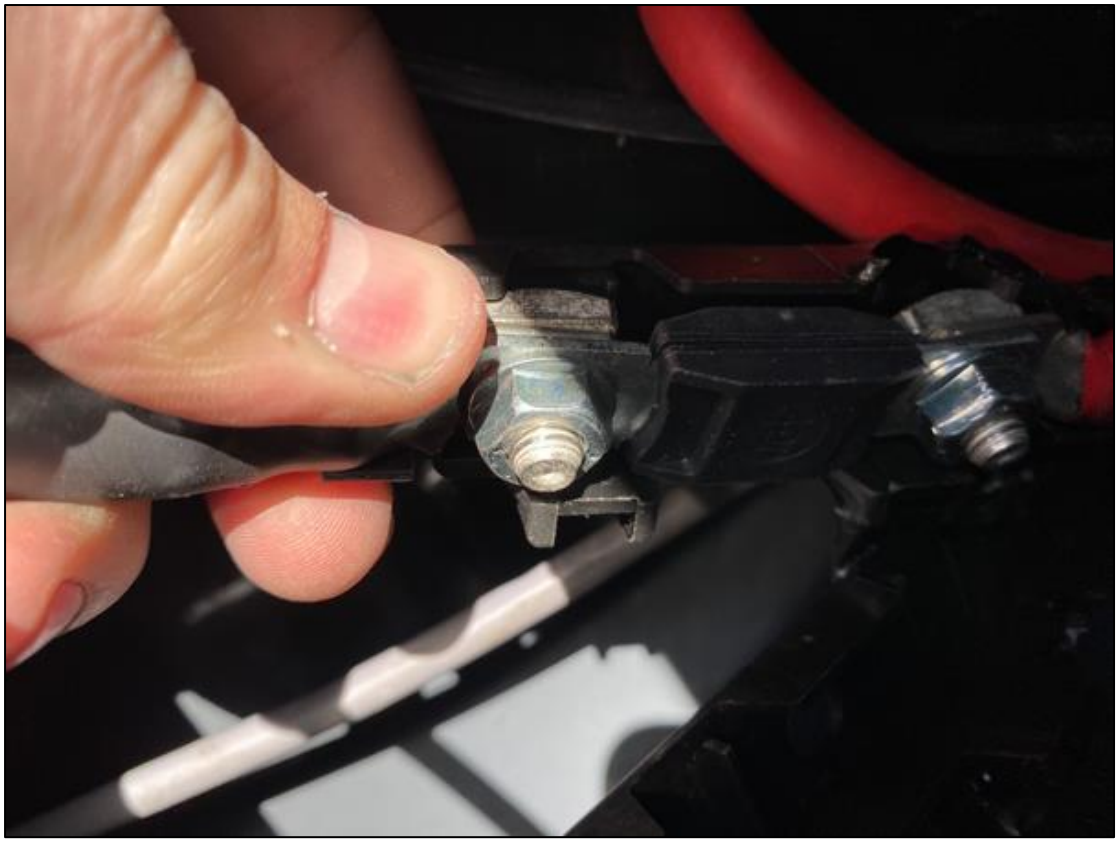
When examining the inverters negative crimped connection to the battery pack with the isolation tape removed, the wire pulled out of the crimp connection with little force.



Photograph 8 – Cable end crimped using improper tooling. Pulled out of connection using very light force.

5.1.2. Inverter Fuse Arrangement

At the time of inspection, the positive DC supply of the inverter was found with a single 400-amp fuse supplying both inverters. The inverters should be individually fused at a rating of 200-amps (according to the manufacturer's installation guide).



Photograph 9 – Incorrectly sized inverter fuse not sitting in housing correctly. Originally wrapped in insulation tape.

5.1.3. Invertor Cable Routing

At the time of inspection, most of the cabling was found unprotected and unsecured. Cabling should be clipped and sheathed to protect the cables from chafing overtime. Best practice would have the cabling protected in plastic trunking secured every 30cms (ISO, 2012. *Small craft — Electrical systems — Extra-low-voltage d.c. installations*. 3rd ed. Geneva, Switzerland: International standard ISO 10133).

At the time of inspection, cabling to the inverters was found running though the opening in the metal bulkhead without any sheathing protection.

Photograph 10 – Cabling running through bulkhead without chafe protection.

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EMAIL: ALEX@ALEXLLOYDMARINESURVEYOR.COM
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5.2. Bow Thruster Installation/Charging Arrangements

At the time of inspection, the vessel was fitted with a 5.7kW 24-volt Vetus bow thruster. The bow thruster electrical power is supplied by two Exide 12-volt ER550 batteries connected in series to provide 24-volts. Charging is supplied by a 12/24 volt, non-automatic, battery charger, manufactured for/by Draper (part number: BCD11).

The draper charger has been permanently wired to the vessel without any DC protection. The Draper BDC11 charger is designs for use in a home workshop environment. It is not designed to be permanently installed and does not have any kind of autosensing for shutting down once the batteries are fully charged. Furthermore, the battery charger has not been secured.

Marine grade chargers are generally IP rated to a grade suitable for the marine environment. The importance of using a suitable marine charger onboard vessels cannot be overemphasized. Marine chargers use isolated type transformers with primary and secondary coils that are only connected magnetically. No electrical connection is present between AC and DC circuits. Less expensive automotive type chargers use an autotransformer, whose windings are not electrically dependent of each other. If the two circuits are not isolated there is a danger of stray currents being introduced into the vessel that pose a shock hazard, and may setup stray currents in the water around the vessel (Brotherton, M. and Sherman, E., 2003. *The 12-volt bible for boats*. 2nd ed. Camden, Me.: International Marine/McGraw-Hill).

Photograph 11 – Automotive, non-automatic charger connected to bow thruster batteries.

5.2.1. Thruster Installation

At the time of inspection, the main negative terminal connecting the thruster to the battery pack was found loose. Evidence of arcing by way of burn marks were present on the thruster's negative power post, connecting nut and washer.

Photograph 12 – Nut and washer found loose on negative bow thruster terminal showing signs of arcing/excessive heat.

5.2.2. Battery Termination

At the time of inspection, the battery link wire (series connection) terminal on the aft most battery was found loose. Evidence of heavy arcing between the battery terminal post and battery terminal was present. The battery post terminal has been partly melted. A new battery is now required.

Photograph 13 – Bow thruster battery post (negative) showing severe signs of continuous arcing due to poor connection/loose terminal.

Photograph 14 – Bow thruster battery clamp (negative) showing severe signs of continuous arcing due to poor connection/loose terminal.

Photograph 15 – Bow thruster battery post (negative) showing severe signs of continuous arcing due to poor connection/loose terminal.

5.2.3. Thruster Fuse

At the time of inspection, the bow thruster was installed using a 425-amp fuse. According to the manufacture's specifications, the 95kgF (kilogram force) 24-volt Vetus thruster should be installed with a 200-amp slow burn fuse.

6.0. 12-VOLT SYSTEMS

6.1. 12-Volt Panel

At the time of inspection, the vessel was fitted with an unbranded 5-way, 12-volt DC switch panel with LED voltage display and 12-volt output socket.

The switch marked ‘forward power’ appears to control the two water pumps. The forward power switch is showing evidence that suggests it has been hot to the point of melting the switch mechanism. The switch has now melted into the permanently on position.

Photograph 16 – Evidence of high resistance/excessive heat to water pump switch (ceased closed)

Photograph 17 – Switch showing a temperature of 60.6°C after 60 seconds of operation.

6.2. Voltage Dropper

At the time of inspection, the vessel was installed with a Tocsin THJ4812C300Z 25-amp, 48-volt DC to 12-volt DC voltage dropper/convertor. The rating of the dropper does not meet the demand of the vessels 12-volt systems. Information regarding specification and declaration of conformity should be sort from the boat builder.

The dropper, as with much of the vessel's DC and AC systems, is connected using 32 Amp Wago connections. The total capacity of the vessels 12-volt systems is:

- Water pump one: 11-amps
- Water pump two: 11-amps
- Shower bilge pump: 1.6-amps @ 24-volts (incorrect voltage)
- Navigation lights: 5-amps
- 12-volt socket: Up to 20-amps

The vessels 12-volt system does not appear to have been designed or thought out. There is a high possibility that the demand of the 12-volt system is exceeding the rating of the dropper, Wago's/connections and switches. The boat builder should be able to provide electrical schematics.

6.3. AC/DC General Connections/Wiring Runs

Where access allowed, cable runs and cable connections were examined. Much of cabling was found unprotected and unsecure. Cabling should be clipped and sheathed to protect the cables from chafing overtime. Best practice would have the cabling protected in plastic trunking secured every 30cms (ISO, 2012. *Small craft — Electrical systems — Extra-low-voltage d.c. installations*. 3rd ed. Geneva, Switzerland: International standard ISO 10133).

7.0. OWNER'S MANUAL

According to regulations set out by ISO10133 'Small craft – Electrical systems– Extra-low-voltage d.c installations' manual, the following should be included within the owner's manual:

- Diagram(s) identifying the electrical circuits of the craft with the locations of electrical devices in the craft and identification of conductors by colour or other means.
- Location and description of functions of electrical controls, dials, switches, fuses, and also circuit-breakers installed on a panel-board.

The information contained within the vessel's manual is not satisfactory.

8.0. HEATING AND HOT WATER SYSTEMS

8.1. Thermal Accumulator

At the time of inspection, the vessel was installed with a Victoria Elegance B wood burning stove. Rated to 4.19kW (space heating)/5.07kW (water heating).

The back boiler of the stove is connected to an underfloor heating system and hot water tank. The hot water tank is installed to operate as a reverse calorifier (thermal accumulator). The main body of water within the tank is used as the

heating source whilst the consumers gather/absorb their heat through coils within the tank. In theory, this allows the system to store its energy using the large body of water as thermal mass.

On the day of inspection, the stove was lit at 08:00hrs and feed dried seasoned timber until 14:00hrs. During this time, the maximum water temperature from the output pipe of the fire was recorded at 37°C (degrees Celsius). The temperature at the tank input was 35°C.

The temperature of the stove body reached above 115°C. The underfloor heating circuit was measured at 34°C. The temperature of the timber floor was monitored throughout the day of inspection. At no point did the temperature increase.

Cordivari, the thermal accumulators manufacture, offers examples of heat exchange power in kW, assuming a heat sauce inlet temperature range of 80°C and an outlet temperature of 70°C, making the average stored water temperature 60°C. At this range the temperature difference between the primary and secondary is 20°C.

The example on the graph provided by Cordivari, claim that the 500-litre tank would produce approximately 12kW of heat exchanger power considering a low rate of 3m3/h.

Taking the values recorded on the day of inspection, with a heat source inlet temperature of 35°C and an outlet temperature of 34°C, the midpoint of the tank was measured for an approximate average stored water temperature of 34°C. At this range the temperature difference between the primary and secondary is 1°C.

Using the same graph provided by Cordivari, the 500-litre tank found on board Solar 6, coupled with the wood burning stove, is currently producing under 0.2kW of heat exchanger power considering a low rate of 3m3/h.

After 6 hours of continuous burning/running, the water pump was turned down to its lowest setting and the flow of water was purposely restricted to slow the flow of water circulating around the stoves heat exchanger. At this time, temperatures of 40°C were recorded at the thermal accumulator's heat source input pipe.

Testing, coupled with the manufacture's specifications and examples, concluded that in order to get continuous hot water for a comfortable shower, the temperature of water within the thermal accumulator would need to reach a minimum average of 50°C. Other thermal accumulators manufacture require/recommend a temperature between 70°C and 80°C to operate efficiently.

Thermal Store Problems

The THERMflow thermal store continues to be one of the most reliable hot water cylinders on the market today, however issues can arise from time to time.

Below contains a guide to a few of the problems which can arise with thermal stores.

If this does not resolve your problem, please contact either your installer or phone McDonald Water Storage Technical Team on 01592 611123 for further advice.

Symptom	Solution
The water at the tap is lukewarm or cold.	The thermal store is designed to work best when the store temperature is at or approaching 75°C – 80°C. While the thermal store can provide hot water at lower temperature storage, the available flow rates and volume will be reduced. Check the thermometer is showing the store temperature is at or approaching 75°C -80°C. If this is not the case, ensure that the boiler is firing and allow sufficient time for the store to reach working temperature.
The thermal store is at 80°C and the water at the taps is still lukewarm or cold	1. If the store is at or approaching 75°C – 80°C, check that the Thermostatic Mixing Valve is turned to hot. The maximum temperature of water from the Mixing Valve is 55°C. 2. If the valve is turned fully to hot, check that the flow rate at any outlet (e.g. bath tap) does not exceed 20 Litres per minute. If the flow rate is above this, then turn the tap down slightly. 3. If Stage 1 and 2 has not resolved the problem a competent installer should check the mixing valve for blockages within the internal filter of the mixing valve.
Not enough hot water and less than 80°C on the thermometer.	Check the heat sources and their input in (kW) to the store as this will be lower than the kW output which will result in the store not producing enough heat for the exchanger to provide heated mains pressure water.
THERMflow is set at 80°C but the mains pressure temperature drops quickly when running a tap (e.g. bath)	1. Check with the installer that inhibitor has been put in frequently. If the DHW Coil is giving an initial heat transfer and then fading this could be a sign of sludge build up surrounding the Heat Exchanger Coil, which will reduce the performance of the store. 2. If Stage 1 does not resolve the problem level of input and output may be affecting performance, this is tested by drawing off the same flowrate of water when the output is lower, such as turning your heating off.
There is a brownish tint to the mains pressure hot water.	This could be a symptom with the heat exchanger coil leaking inside the thermal store. An installer should have this tested. If this is the case, pay attention to the Feed & Expansion Tank as the pressure within the store will increase causing the tank to overflow continually.

McDonald Water Storage. 2022. *Thermal Store Problems - McDonald Water Storage*. [online] Available at: <https://mcdonaldwaterstorage.com/thermal-store-problems/> [Accessed 31 March 2022].

8.2. Underfloor Heating

Typically, the temperature in an underfloor heating system needs to be between 35°C and 55°C depending on insulation/heat losses and floor substrate.

Elements effecting the effectiveness of the under-floor heating system include:

- Temperature of water flowing through the pipe work.
- Thickness and thermal qualities of the floor covering.
- Heat losses through improper insulation.

As concluded in section '8.1. Thermal Accumulator' the temperature flowing through the underfloor heating circuits is approximately 34°C.

Above the underfloor heating pipework is 16mm plywood and 14mm wooden flooring. In general terms, timber is considered an insulator. With 30mm of timber insulation above the underfloor heating pipework, there will be little or no heat transfer through the timber into the living spaces.

Starting from the vessel base plate, the flooring substrate consists of:

- 10mm thick mild steel plate
- Concrete blocks
- Kingspan insulation
- Underfloor heating pipework partitioned with timber battening and backfilled with pea shingle

It is understood that the intension of the pea shingle is to create a thermal mass. A monolithic effect as would normally be created with clement/sand screed mixture under the ceramic tiles within a house.

The term monolithic is used to describe a single piece of rock/stone. In order to create thermal storge as seen in concrete structures, the pea shingle would need to be mixed with a binding agent to create a single mass. The individual stone will simply not work as required. Additionally, the type of stone used may contain high levels of Silica and will act as an insulator.

Photograph 17 – Underfloor heating arrangement. Photograph taken during build, taken by owner.

9.0. AIR RECOVERY SYSTEM

At the time of inspection, the vessel was installed with a DHV04/100B heat recovery system. The system takes warm air at ceiling level from the galley area. The warm air then passes through a heat exchanger warming up the fresh air being draw from outside the vessel. The system is partly performing as expected. When measuring temperatures at the heat exchanger, the system is warming the incoming air to within 1°C of the warm air being draw into the exchanger.

Although the temperature readings at the exchanger are proving the system is recovering heat, the lack of isolated pipework means that by the time the fresh air is expelled within the vessel, the air is no warmer than the outside temperature. This could be rectified by installing insulated ducting.

Temperature readings taken at the time of inspection:

High level, internal intake vent (heat source)	26.8°C
Heat source measured at exchanger	22.1°C
Fresh external air measure before heat exchanger	18°C
Heated air measured at heat exchanger	21.4°C
Heating/fresh air outlet in forward cabin	16.3°C

According to the manufacture, the air recovery system should be mounted horizontally. The unit found aboard at the time of inspection was found mounted vertically.

10.0. PLUMBING SYSTEMS

The pumping system is made up using a speed fit system. The installation is considered untidy. Much of the pipework where seen, is unclipped and is putting excessive strain on the speed fit connections. Several of the speed fit connection appear to be cross threaded.

10.1. Shower Enclosure

Reportedly, at the time of vessel delivery, the shower enclosure did not drain. This issue has not yet been rectified. In order to identity and rectify this issue, the shower enclosure may need to be dismantled.

In an attempt to free up the drainage, having discovered silicone sealant blocking another pipe, the customer punctured the pipe using a plumbers drain coil. To replace the pressure fitting on the trap beneath the tray, access may be gained by cutting a section out of the floor, if it is possible to avoid the underfloor heating pipes. The other option is to remove the shower tray. This would need to include the removal of the enclosure screen and the wall coverings.

10.2. Toilet Installation

A waterless composting toilet is installed on the vessel. The system separates liquids and solids. The solids are then constantly ventilated/dried using a mechanical ventilation forcing all the associated smells outside the vessel.

10.3. Toilet Vent/Skin Fitting

The aperture for the toilet vent in the vessels hull is approximately 150mm from the vessel's waterline. The plastic fitting is not sealed to the vent pipework. Any wave higher than 150mm will mean river water is entering the vessel without any means to drain. According to the vessels 'Declaration of Conformity' the vessels is intended design category is 'D'. D category vessels should be considered and designed for a wind force up to, and including four, and significant wave height up to, and including, 300mm, with occasional waves of 500mm maximum height.

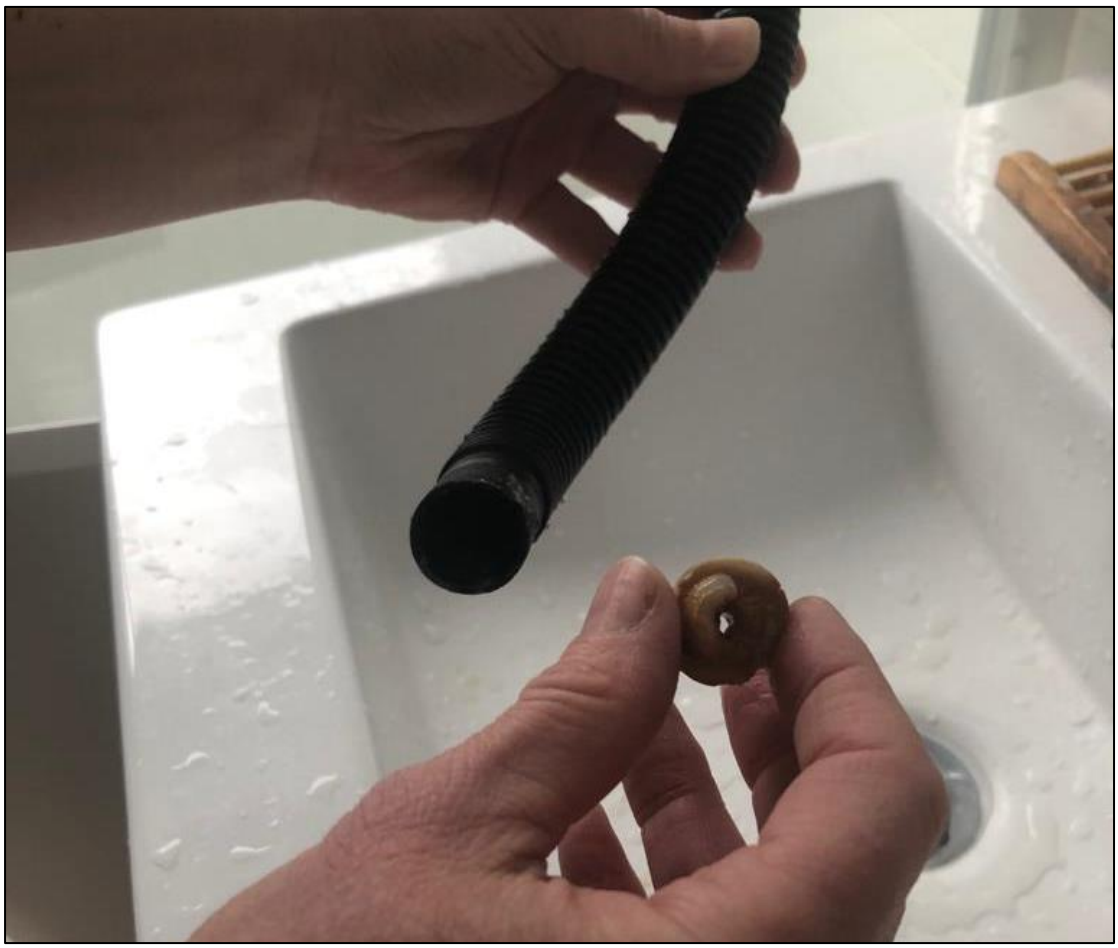
Photograph 18 – Toilet vent/open to hull.

Photograph 19 – Aperture in hull cut at 150mm above waterline.

ALEX LLOYD MARINE SURVEYOR
EMAIL: ALEX@ALEXLLOYDMARINESURVEYOR.COM
WEBSITE: WWW.ALEXLLOYDMARINESURVEYOR.COM
TELEPHONE: 07887802746 / 01480 384560

10.4. Liquid Pipe / Draining Issues

Reportedly, pre-inspection, the owners of the vessel experienced issues with the liquid section of the toilet system backing up. Upon further inspection, silicone sealant was found partly blocking the liquid pipe between the toilet and the sump pump drainage system.



Photograph 20 – Silicone sealant found by owner blocking urine pipe.

At the time of inspection, the vessel was fitted with a 24-volt shower drain pump being supplied by 12-volt system. Installing a 24-volt motor onto a 12-volt system will make the pump motor at approximately half is intended design speed.

11.0. AC SYSTEM

The AC electrical system found on board Solar 6 does not include any galvanic protection. Although this is not mandatory, it is very unusual not to find a vessel with this level of equipment that is not protected by an insulation transformer.

As with all cables found on the vessel, there is little clipping up or chaffing protection found on the AC system.

12.0. GENERAL BUILD QUALITY/CARPENTRY

The general fit out and finished carpentry throughout the entire vessel has been carried out to an unprofessional and basic level.

13.0. REMEDIAL WORKS AND RECOMMENDATIONS

All remedial works and recommendations are colour coded based on their severity:

RED: Urgent: Currently affecting the usability of the vessel.

ORANGE: Non-Urgent: To be carried out as part of the vessel's routine maintenance (within 12 months).

BLUE: Minor: These faults are normally cosmetic and have little impact towards the usability of the vessel.

GREEN: Suggested Improvements: Upgrades.

13.1. Electric Propulsion and Associated Equipment		
Code	**Observation**	**Recommendation**
■	The current cable size suppling the motor controllers are under the manufacture's specification.	According to the manufactures specification the large-framed motor controllers should be install with 70mm2 positive and negative cable.
■	Non continuous cables varying in size.	Insure all high-capacity cables are continuous runs. Avoid unnecessary connections.
■	Cable connections/termination between fuse-holder, battery switch and batteries are inadequately made.	All terminations should be correctly crimped using the correct tools. Copper tube terminals should be covered with heat shrink.
■	Loose terminal connection to battery switch.	Tighten to manufactures torque specification.

	Unsupported and unprotected wires cabling to motor controllers.	All cable/wiring on board the vessel should be clipped up neatly at least every 300mm. All cable/wiring should be protected from chaffing using conduit as required.
	Tension on cable terminations due to supported cable.	As above. Ensure termination on appliances do not hold the weight of draping cables.
	Both 50mm2 and 35mm2 cable sizes within the same run of cable.	Cable size should remain continuous throughout its run.
	Cable runs do not contain circuit protection.	Although the motor controllers contain their own fuses, the run of cable should also be protected.
	Wiring, including helm/throttle control cables are running through metal openings unprotected.	All cables/wiring on board the vessel should be clipped up neatly at least every 300mm. All cable/wiring should be protected from chaffing using conduit as required.
	Motor controllers not fastened down as per the manufacture's specification.	Bond in timber backing boards or weld in mounting frame. Secure the motor controllers using the four (per controller) mounting points provided.
	The Lynch motor controller LCD screen is unreadable due to condensation in the unit.	Replace screen with a display suitable for outside conditions.
13.2. Hull, Deck and Superstructure		
	Aperture in hull topside (port side). 150mm above the water line. This does not comply to category D regulations.	Repair by fully welding 6mm plate from both sides. Welding should be carried out by a professional welder. The welding should be continuous and free of inclusions. Area should then be prepared, primed, and refinished to suit the vessels current two pack finish.

	Craft over 18 meters should be installed with 6 strong points (Anchoring Mooring Towing)	Guidance as per the British Marine Federation. Harmonised standard BS EN ISO 15084
13.3. Electrical System		
	The bow thruster fuse size is incorrect.	The thruster should be protected with a 200amp fuse.
	48-volt battery pack is inadequately secured.	Install batteries in appropriately sized timber/fibre glass/plastic battery box with lid.
	Battery termination is poor. Improper tooling used to make connections. Cables pull out of terminals with light force.	All terminations should be correctly crimped using the correct tools. Copper tube terminals should be covered with heat shrink.
	Many electrical cables were found running unprotected through steel bulk heads.	Install chaffing/vibration protect to all cables running through steelwork.
	The bow thruster battery charging arrangements are uncontrolled, the charger is not intended for marine use, or designed to be permanently installed. The charger body is unfixed.	Remove charging system. Install automatic permanently fixed marine charger. All connections/terminations should be made in accordance with the manufacture's specifications.
	Termination/connections on the bow thruster were found loose. Evidence of arcing and excessive heat were present.	Ensure all electrical connections are well made and fastenings are tightened to the product manufactures specification.
	Loose termination on bow thruster battery to battery series linking wire. Battery terminal post has melted.	Replace battery pack. Correctly install new terminals. Ensure terminals are tightened to the manufacture's specification.
	Invertor isolation switch size. Both invertors are running	Replace the switch with 300+ amp continually rated switch.

	though the same isolation switch. The switch specification is unknown. Both invertors running at capacity will draw 274 amps through the switch.	
■	No evidence of invertor CE marking.	Obtain declaration of conformity from the boat builder.
■	Invertor fuse size. The Inverters are linked to the same 400-amp fuse.	The inverters should be individually fused as per the manufacture's specification.
■	Invertor cable termination.	All termination should be correctly crimped using the correct tools. Copper tube terminals should be covered with heat shrink. Studs should be tightened according to the product manufacture specifications.
■	Invertor cable run/size. 35mm2 cable is not adequate	The inverters should be individually connected. There are currently overloading the single 35mm2 cable.
■	Invertor chassis is not earth bonded.	Chassis of electrical equipment such as chargers and inverters should be bonded back to the vessels hull or earth bonding plate. Incoming (shore) AC systems should be bonded to the same circuit.
■	48-volt to 12-volt dropper is rated at 25-amps.	Obtain declaration of conformity from the boat builder. The rating of the dropper does not meet the demand of the vessels 12-volt systems.
■	12-volt switch/distribution panel is overloaded. Heat on the pump circuit has damaged the switch.	Unknown panel. Replace using adequately rated switches.
■	All battery isolation switches are believed to be underrated.	Obtain supporting documentation from boat builder of replace battery switches to correct specifications.

	No galvanic transformer installed.	As the vessel is permanently plugged into the marina power supply during the winter periods, a suitable galvanic transformer should be installed to isolate the vessel, stopping a potential route for earth leakage through the vessels metal work.
	Battery isolation switch location not labelled.	Make location for all battery isolation switches clear.
13.4. Heating and Plumbing		
	The underfloor heating system is not effective. At the time of inspection there was no temperature difference measured over a 6-hour period.	Multiple issues with underfloor heating system. Independent inspection from specialist recommends removal and reinstallation.
	Multiple plastic pipe fittings/connections are not made correctly. Cross threading of fittings. Poor workmanship.	Make all connections as per the product manufacturer's recommendations. Fittings are not designed to take the weight of a run of pipework.
	Excessive forced applied to multiple fittings due to poor workmanship. Incorrectly/unsupported pipework.	Make all connections as per the product manufacturer's recommendations. Fittings are not designed to take the weight of a run of pipework.
	Plastic fittings found within 1 meter of uncontrolled heat source (stove).	It is recommended that all pipework within 1 meter of an uncontrolled heat source is metallic.
	The voltage of the shower/toilet drain pump is incorrect. The vessel uses a 48 to 12-volt dropper. There is no 24-volt system on board the vessel.	Replace the 24-volt pump with a 12-volt item. Ensure the circuit and dropper are correctly specified and fused to deliver the required load. All loads of the same circuit/dropper should be considered.

■	Both 12-volt water pumps were found unsecure.	Secure water pumps as per the manufacturer's recommendations.
13.5. Other		
■	The floor under the vessels water tank and stove appears to have dropped.	Further investigation required. It is likely that the supporting beams have sunken into the Kingspan insulation.
■	Evidence of water ingress into the engine/battery bay.	Ensure the engine bay is kept clean and dry. Electrical equipment within the engine/battery should always remain dry.
■	The speciation of the vessels bow thruster is incorrect. The motor is not brushless.	Modify manual to suit.
■	Services details within the manual are wholly inadequate.	Detailed and accurate wiring diagrams, including circuit protection and proof of adequate system design, should be included within the vessels manual.
■	The warm air recovery, ventilation system is not performing as intended.	Insulated trunking must be used to preserve the temperature of the air as it is delivery around the vessel. Additionally, the manufacture states that the heat exchanger should be installed flat/horizontally, and not vertically as found aboard Solar 6.

14.0. CONCLUSION

In its current state, the wide beam vessel ‘Solar 6’ is not considered to be fit for purpose, nor does it meet the specifications required to meet the recreational craft directives category D rating.

The vessels systems appear to have been installed with minimal regard or understanding for basic boat building practices, RCD standards, boat safety regulations or individual appliance specification and guidance.

The level of workmanship in all areas including electrical, plumbing, joinery and general fit-out is that of someone without the requisite skills, experience and understanding.

At the time of inspection, multiple electrical issues were present which have the protentional to become hazardous to life.

Evidence of declaration of conformity must be obtain for all appliances permanently installed on the vessel. These declarations should be kept with the vessel’s paperwork.

At the time of inspection, no fixed panel removal took place. Further, potentially dangerous issues may not currently be visible.

The vessel is not currently insurable.

15.0. SURVEYERS DECLARATION AND SIGNATURE

Date: 12th April 2022

Signed: Alex Lloyd

Company Registered Address: 71 Tudor Road, Godmanchester, Cambridgeshire, PE29 2DW

REPORT ENDS

ALEX LLOYD MARINE SURVEYOR
EMAIL: ALEX@ALEXLLOYDMARINESURVEYOR.COM
WEBSITE: WWW.ALEXLLOYDMARINESURVEYOR.COM
TELEPHONE: 07887802746 / 01480 384560

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16.0. STANDARD MARINE SURVEY TRADING TERMS

Liability and Limitations

1. All services and reports are provided for our named Clients' use only. No liability of whatever nature is assumed towards any other party and nothing in these terms, or the relationship between us and our Clients, shall confer or purport to confer on any third party a benefit or the right to enforce any provision of these terms.

2. We shall undertake the services to which these terms relate with reasonable care, skill and diligence, but we shall have no responsibility or liability whatsoever except insofar as the Client suffers loss or damage in consequence of our negligence, gross negligence or wilful default. Notwithstanding any other provision of these terms:

   2.1 our liability shall expire 12 months after completion of the services in respect of which liability is alleged to arise and we shall thereafter have no liability in respect of those services and/or any alleged default in connection with the provision thereof;

   2.2 we shall not be liable in respect of any breach of our obligations (1) for any loss, damage, delay or expense of whatever nature whether direct or indirect (including but not limited to loss of profit and loss of use) and howsoever arising or resulting whether directly or indirectly in the course of or as a result of the provision of our services, under these terms or otherwise, (2) of which written notification shall not have been given within 14 days of the date on which the Client ought reasonably to have become aware of the existence of such breach, or (3) resulting from unforeseeable causes beyond our reasonable control;

   2.3 the Client covenants with us and our servants and agents that no such servant or agent shall in any circumstances whatsoever be under any liability for any loss arising or resulting directly or indirectly from any act, neglect or default on his part while acting in the course of or in connection with his employment and, without prejudice to the generality of the foregoing, every exemption, limitation and condition herein contained and every right, exemption and limitation of liability applicable to us or to which we are entitled hereunder shall also be available to protect every such servant or agent acting as aforesaid and for the purpose of the foregoing provisions we are or shall be deemed to be acting as agents or trustees on behalf of and for the benefit of all persons who are or might be our servants or agents from time to time and

all such persons shall to this extent be or be deemed to be parties to these terms;

2.4 under no circumstances shall our liability exceed a total of 10 times the fee payable hereunder.

Fees

3. Fees and expenses shall become due and payable on such terms and in such amounts as shall be agreed from time to time. VAT or other EU equivalent shall be payable, if applicable, in addition to all fees and expenses. Invoices will be submitted in respect of all fees and expenses when due and the amount of each invoice shall be settled within 14 days of receipt. Interest shall be payable on all amounts owing and unpaid at a rate of 3% above the Bank of England Base Rate.

Default

4.1 Client default: We may terminate our appointment forthwith if the Client fails for more than 14 days to pay any sum due when demanded, or if the Client fails consistently to respond promptly to requests for information and/or instructions and fails adequately to respond to 14 days' formal notice of such failure, without prejudice to our accrued rights.

4.2 Other defaults: Either party may terminate our appointment forthwith by notice if the other party shall: have a petition presented for its winding up or administration which is not discharged within 14 days of presentation or any other action is taken with a view to its winding up (otherwise than for the purpose of reorganisation or amalgamation without insolvency), or become bankrupt or commit an act of bankruptcy, or make any arrangement or composition for the benefit of creditors, or have a receiver or manager or administrative receiver or administrator or liquidator appointed in respect of any of its assets, or have anything analogous to any of the foregoing under the laws of any jurisdiction occur to it, or cease or threaten to cease to carry on business; without prejudice to the accrued rights of the other party.

Surveys

5. All survey work undertaken hereunder shall be on terms that, unless otherwise stated in writing, no guarantee is given against faulty design, latent defects or of suitability of the vessel or other item for any particular purpose or of compliance with any particular local, national or international requirement or code, and opinions are given without the benefit of running of machinery or opening up or other dismantling whether of interior linings, machinery or other items or systems.

Valuations

6. All valuation work undertaken shall be on terms that, unless otherwise stated in writing, such work relates solely to the date and place referred to. Valuations are based on opinions only and are not representations of fact, nor do they carry with them any guarantee of the particulars or information on which our opinions are based. Valuations assume a willing buyer and willing seller and market conditions applicable at the time of valuation or such other date as is expressly referred to.

Law and disputes

7. These terms shall be governed by and construed in accordance with English law and any dispute or difference arising, or claim made, between or by the parties out of or in relation to or in connection with the provision of services to which these terms relate and which cannot be resolved by the parties shall be submitted to the non-exclusive jurisdiction of the High Court of England and Wales.

Miscellaneous

8. No exercise or failure to exercise or delay in exercising any right, power or remedy vested in either party shall be deemed to be a waiver by that party of that or any other right, power or remedy.

9. Neither party shall transfer or assign its rights or obligations under these terms without the prior written consent of the other.

10. In the event that any provision of these terms is held to be a violation of any applicable law, statute or regulation the same shall be deemed to be deleted from these terms and shall be of no force or effect and these terms shall remain in full force and effect as if such provision had not been contained therein. Notwithstanding the foregoing in the event of any such deletion the parties shall negotiate in good faith in order to agree the terms of an acceptable alternative provision.

11. These terms form the entire agreement between the parties and supersede all previous agreements and understandings between the parties, and no warranty, condition, description, term or representation is given or to be implied by anything said or written in negotiations between the parties or their representatives prior to the communication of these terms.

12. References to "we" and "us" include our employees and persons, firms and companies appointed or engaged by us as our agents for carrying out any work or services under these terms, all persons, firms and companies to whom performance of any work or services under these terms is sub-contracted or delegated by us, and all agents and employees of persons, firms and companies referred to in this clause.

13. Any communication required to be given under these terms by either party shall be in writing and shall be sufficiently given either by letter, fax or electronic mail (provided the same is capable of being recorded by the recipient in durable form) sent to the other at the contact details previously notified and any such notice shall be deemed to have been given at the time at which it would in the ordinary course of transmission have been received.

14. Both parties undertake to maintain the confidentiality of all information supplied by each other and not to divulge such information to third parties without the prior written authority of the other.

18.0. GLOSSARY OF TERMS

AC	Alternating current
Aft	The rear of the boat.
Air Draft	The height of the boat taken from the waterline to the highest fixed point on the boat.
Amidships	Central part of a boat.
Anode (Steel Vessel)	A magnesium conductor bolted or welded under the waterline at the front and rear of a narrow boat hull, which protects the hull from electrolytic corrosion. An inspection of the anodes is recommended when the boat is out of the water for blacking.
Anser Pins	Steel hooks and shackles attached to the gunwales of narrow boats and butties immediately before the stern counter used to keep the sterns together when breasting-up.
Anti-Cavitation Plate (Steel Narrow Boat)	On a narrow boat a plate fitted flush to the uxter plate to cover the weed hatch opening used to improve hydraulic performance of the propeller and to reduce backwash up the weed hatch.
Anti-Foul Paint	A marine paint composition containing poisonous ingredients, which prevent or retard fouling or marine underwater growth on a vessel's underwater area. Mercuric oxides are the chemicals generally blended to act as repellents to the undesirable growth.
Athwartships	Having a position across a vessel from side to side at right angles to the chines.
Ballast	High-density material placed in the hull of a boat below the waterline to counteract the effects of weight above the waterline and keep the boat stable in the water.
Beam	The width of a vessel at the widest point.
Berth	A bed or sleeping accommodation on a boat or ship.
Bilge	The compartment at the bottom of the hull of a ship or boat where water collects and must be pumped out of the vessel.

Bilge Pump	A pump for removing water that has collected in the bilges.
Blacking	The term used for protective coats of bitumen-based paints applied to steel hulls to prevent rusting.
Boatman's Cabin	Originally the after cabin on working boats, which provided the crews living and bedroom accommodation. Often replicated on modern traditional style boats.
Bottom Plate	On a narrow boat the heavy 'flat bottom' plate that extends from the stem to the skeg and is almost the entire width (beam) of the vessel.
Bow	The front of the vessel.
Bow Thruster	A small propeller or water-jet at the bow used to turn a vessel at slow speed. Often mounted in a tunnel running through the bow.
Brightwork	Exposed varnished wood or polished metal on a boat.
Bulkhead	An upright wall within the hull of a boat. Particularly a structural wall, which is often watertight.
Bulls Eye	A small round porthole fitted in the cabin top and has convex glass for lighting the cabin.
Bulwark	The extension of the vessel's hull wall above the level of the weather deck.
Butty	An unpowered narrow boat towed behind another. Often seen in the days of working boats.
Calorifier	Hot water tank heated by the running engine immersion central heating or connected to 240V shoreline (can be a combination)
Cant	On a narrow boat, a raised outer section of a deck normally to the fore and counter decks.
Chine	An angle in the hull. There may be several chines depending upon the hull design.
Coaming	The raised edge of a hatch cockpit or skylight.
Cockpit	The area usually positioned towards the stern of a small decked vessel that houses the rudder controls and seating.
Companionway	A stairway from one deck to another.

Counter	The part of the stern above the waterline that extends beyond the rudderstock. On a narrow boat the counter stern is trimmed to float at the waterline.
Counter Plate	On a narrow boat, the stern section of the hull side plating above the waterline that wraps around the stern and corresponds to the counter swim.
Cratch	A canvas covering over the forward well deck.
Cratch Board	A triangular board or frame supporting the forward end of the cratch covers.
Cross Bed	A double bed going across the full width of the boat the bottom of the bed folds or slides away during the day for gangway access.
Cruiser Stern	A back deck of between 4-8 Feet in length providing ample space on the vessel for several people to stand and socialise
DC	Direct current
Deckhead	The under-side of the deck above sometimes covered by the head lining.
Dinette	A seating arrangement with storage under and demountable table, which converts, to a bed.
Displacement	The weight of water displaced by the immersed volume of a vessel's hull and equal to the total weight of the vessel.
Displacement Hull	A hull design that travels through the water rather than planing over it.
Dolly	A metal bollard usually on the counter of a narrow boat or canal boat used for securing ropes to when mooring or towing.
Draft	The depth of water a vessel draws from the waterline to the lowest part of the keel.
Electrolytic Corrosion	An electrochemical process in which one metal corrodes preferentially to another when both metals are subjected to an electrical current within the presence of an electrolyte, i.e. The water in which the vessel floats.

Fair	A smooth curve usually referring to a line of the hull, which has no deviations.
Faucet	A tap or cock for controlling the flow of a liquid.
Fender Eye	Attachment point for fenders usually fitted at deck level.
Fiddle	A raised lip or rail around the edge of a shelf to prevent items from sliding off.
Flare	The widening of the topsides outward from the waterline to the gunwale.
Foot Or Footing	The lower section of the hull side.
Fore Well	The lower deck at the front of a boat.
Foredeck	The higher level deck in the bow of a boat. This is often over the gas locker in a narrow boat or the chain locker on a cruiser.
Forepeak	The extreme forward part of the interior of a hull
Frame Or Framing Member	A transverse structural member, which gives the hull strength and shape.
Freeboard	The distance between the waterline and the lowest deck level where water can enter the inside of the boat.
Galley	The kitchen area of a boat.
Galvanic Corrosion	An electrochemical process in which one metal corrodes preferentially to another when both metals are in electrical contact within the presence of an electrolyte, i.e. The water in which the vessel floats.
Galvanic Isolator	A fitting to a boats electrical system intended to prevent corrosion to the hull.
Ground Equipment	Metal steaks and rods that are hammered into soft ground for securing mooring lines and ropes. (See Mooring Pin)
Gunwale	Upper edge of the hull.
Heads	A name retained from the past for a modern lavatory and flushing mechanism.

Holding Tank	An on-board storage tank used for toilet waste emptied at pump out stations.
Holiday	A gap in the coverage of paint or other coating.
Houdini Hatch	A skylight fitted to the roof of the cabin, which can be opened for ventilation or emergency escape.
Hull Speed	The maximum efficient speed of a displacement hull.
Inverter	Electronic device for taking power stored in the battery bank and converting 12v DC to 240v AC.
Josher Style Bow	A bow design with a more pointed nose with a slight S shaped sweep named after Joshua Fellows of Fellows Morton and Clayton carriers fame.
Keel Cooled (Steel Narrow Boat)	A closed system of a tank welded to the inside of the vessel's swim. Engine cooling water is then circulated through it, transferring the heat to the canal or river water. Important Note the engine and cooling system can easily have anti-freeze added to prevent frost damage.
kgF	Kilogram-force.
kW	Kilowatt
LED	Light-emitting diode.
Lifting Ring	A recessed handle often fitted to deck boards on boats.
Loa	Length overall; the length of a vessel from the forward edge of the stem to the aft edge of the stern post.
Macerator Toilet	Pump out toilet where the waste is macerated into slurry.
Mill Scale	Mill scale is an oxide layer that can be found on steel that has been hot rolled. Mill scale forms on exterior surfaces of sheets and plates as they are being manufactured through rolling steel billets and hot iron into rolling mills. Mill scale typically consists of iron oxides that are bluish black. The thickness is about 0.1mm and it is highly cathodic. It will prevent adequate adherence of paint products.
Monkey Box	A wooden storage box in a boatman’s cabin believed to be called after a make of polish.

Mooring Line	A rope used to hold a narrow boat or canal boat in place when moored. Common types are sisal hemp and polypropylene.
Mooring Pin	A large steel pin driven into the bank to secure the mooring lines of a narrow boat or canal boat to secure the vessel
Mud Box	Water intake filter used in raw water-cooling systems on narrow boats and canal boats to prevent mud weed and other debris being drawn into the system.
Mushroom Vent	A vent in the roof of the boat shaped like a mushroom, which provides ventilation to the cabin.
Overplate	Steel plating welded over corroded steel to produce a new surface.
Pancake Vent	A vent in the roof of the boat with a wide, flat appearance and which provides ventilation to the cabin.
Pigeon Box	A rectangular hole in the deck head covered with a hinged roof used for ventilation.
Port Or Port Side	Left-hand side when standing at the stern facing forward (towards the frontend)
Porthole	A small circular window in the side of a boat.
Porthole Bung	A disc usually made of foam and covered in fabric, which snugly fits into the porthole recess to cut out the light and/or provide privacy.
Pram Canopy	Canopy fitted on folding framework, which is easy to put up and down, fitted over a cockpit to protect the steerer from the elements.
Pump Out Toilet	Toilet where the waste is flushed into a holding tank, which is pumped out at a pump out facility.
Raw Water Cooled (Direct)	Water is drawn in via a mud box (steel narrow boat) or skin fitting (cruiser) before being pumped around the engine to cool it then returned to the exterior. Important Note; the engine and every part cooling system must be completely drained during cold weather to prevent frost damage.
Raw Water Cooled (Indirect)	Water is drawn in via a mud box (steel narrow boat) or skin fitting (cruiser) before being pumped though a heat exchanger mounted on the engine. It is then returned to the exterior. The engines own

	coolant is also pump through the heat exchanger but is kept separate inside the heat exchanger enabling the engine to be protected with anti-freeze. Important Note; The raw water side of the heat exchanger and unprotected parts cooling system must be completely drained during cold weather to prevent frost damage.
Rcd	(Recreational Craft Directive) EEC Mandatory standards for the construction of new boats. The RCD certificate lasts four years after which boats must have a Boat Safety Certificate.
Remote Greaser	A metal cylinder fitted close to the stern tube, which acts as a reservoir to grease the stern gland.
Reverse Layout	An interior layout of a steel narrow boat with the bedroom at the front and the galley and lounge at the rear.
Rubbing Band	A band of resilient material fitted around the outermost perimeter of the hull to protect against contact damage.
Rubbing Strake	A resilient material fitted to the outside of the hull below the gunwale to protect the topsides.
Rudder Nib	The extension to the rudder above the waterline.
Rudderstock	The bar tube or post connecting the rudder vane to the steering mechanism.
Rudderstock Tube	A tube in the hull through which the rudderstock passes.
Rusticle	A formation of rust that occurs underwater when iron or steel oxidizes. Rusticles are created by microbes that consume iron.
Sacrificial Chine	An additional plate welded to the bottom plate to provide protection and a wear edge for the chine. Commonly seen on the starboard aft section of a narrow boat where it has the deepest draft and is susceptible to wear.
Sampson Post	A strong post with outset 'arms' and often used as a mooring point.
Scantlings	The collective dimensions of the various parts, particularly the vessel's framing and structural supports.

Scuppers	Holes cut in the hull side or toe rails allow water to drain from decks.
Sea-Cock	A valve in the hull of a boat below the waterline.
Sheer	The concave curve of the deck line from the bow to the stern.
Ships Papers	The documents that a vessel must carry and make available for inspection by legal authorities, including documents relating to the vessel's ownership, cargo, and safety.
Shoreline	A lead from the shore side connected to a 240v electricity supply.
Single Lever Control	A hand lever combining the functions of steering and throttle control.
Skeg	A downward or sternward projection from the bottom plate in front of the rudder. On narrow boats the skeg usually has a bearing that supports the rudder.
Skin Fitting	A through hull fitting on a boat usually providing waste outlets for domestic plumbing and inlets for engine cooling.
Skin Tank	A steel tank welded to the interior face of the hull. The skin tank forms part of the engine cooling system; coolant passes through the tank and is cooled by contact with exterior hull plating.
Soap Holes	Small storage slots in the bulkhead of a traditional style boatman’s cabin.
Speedwheel Control	A small wheel that controls the throttle via a system of revolving rods connected to the engine. Most common on traditional narrow boats with a separate engine room.
Squat	The effect where the stern of the vessel sinks lower into the water when forward power is engaged.
Starboard	The right side of a vessel when facing the bow.
Stem	The foremost structural member forming the bow and connected to the bottom plate at the forefoot.
Stern	The aft part of a vessel.

Stern Gear	Collective term for the propulsion equipment of a boat aft of the gearbox, which includes the propeller shaft couplings stern tube and stern gland.
Stern Tube	The tube through the hull through which the propeller shaft passes.
Stretching	The boat is lengthened by cutting through and adding a completely new section to make the boat longer.
Stringer	Internal structural member that runs fore and aft.
Stuffing Box	A stern gland which has graphite-impregnated rope packing and external grease lubrication.
Sub Floor	Usually plywood flooring laid over the bilges onto which the final floor covering is laid.
Superstructure	The structures on a vessel that project above the main deck not including masts and rigging.
Swan Neck	The S-shaped steel bar that connects the rudder stock to the tiller.
Swim	The underwater section of the hull side that reduces in beam to allow water to flow to the propeller.
Tee Stud	A T-shaped metal post fixed to the foredeck of a narrow boat or canal boat to fasten the bow rope.
Taff Rail	A safety rail fitted around the stern of a narrow boat or canal boat sometimes having seats or being wide enough to sit on. Most common on cruiser style sterns.
Tiller	A lever used for steering attached to the top of the rudder post. Used mainly on narrow boats and on smaller vessels such as dinghies.
Tiller Bar (Or Extension)	Fits on the swan's neck of a narrow boat to give extra leverage.
Tiller Pin	A metal pin often brass used to secure the tiller bar to the swan's neck on a narrow boat or canal boat.
Toe Step	A small bolt-on step usually attached to the steel cabin sides of a narrow boat or canal boat.
Top Strake	The upper part of the hull side.

Topsides	The surface of the hull above the waterline.
Transom (Narrow Boat)	The normally rounded after (back) part of the boat above the water where the steerer stands.
Tug Style	A narrow boat with a high level long front deck to give it the appearance of the traditional working tugboat whilst providing a large area of usable outdoor living space. It has a Traditional style stern and usually has portholes for windows to further enhance the traditional look.
Tumblehome	The amount a cabin side slopes inwards (to give more bridge clearance).
Tunnel Light	A light with a large beam fixed to the front of a narrow boat or canal boat for use in tunnels to both see and be seen. Car spotlights are commonly used.
Uxter Plate	The plate that forms the bottom part of the counter and lies parallel to the bottom plate. It is also known as the counter bottom plate.
Waterline	The line on the hull where the boat floats.
Weedhatch	An opening in the uxter plate of a narrow boat directly above a propeller allowing a fouled propeller to be cleared while the boat is afloat.
Well Deck	The floor of a well or cockpit.
Windlass Or Lock Key	A cranked handle for opening and closing lock paddles.