Schedule D: Morrelli & Melvin 52' Auxiliary Catamaran
Specifications

1. SUMMARY OF VESSEL SAFETY PROVISIONS

1.1. Construction

1.1.1. The vessel is designed and constructed in excess of ABS standards. The vessel plans have been reviewed and approved by the New Zealand survey authority as required for commercial service.

1.1.2. Hulls, underwing and cabintop are constructed of epoxy-impregnated E-glass sandwich, utilizing Core-Cell impact-resistant cores of 1", 1.25" and 1.5" thickness respectively. All decks and bulkheads are epoxy-impregnated E-glass sandwich utilizing a minimum of 0.75" end grain balsa core material. Areas of higher stress are carbon-fiber reinforced. All laminations are vacuum-bagged, and all epoxy E-glass laminates exceed 60% fiber/resin ratio.

1.2. Watertight Integrity

1.2.1. Every effort has been undertaken in design and construction to ensure that the vessel survives collision or grounding in navigable condition. The vessel is inherently bouyant in fully loaded cruising trim due to the lightweight composite construction. If all watertight compartments are penetrated the vessel will float with bridgedeck cabin sole at the flooded waterline.

1.2.2. The stem of both hulls is heavily reinforced with Kevlar fiber.

1.2.3. Watertight compartments: The forward section of each hull is sealed by two watertight bulkheads. The first watertight bulkhead is 2-ft aft of the cutwater (the intersection of the stem and the loaded waterline). Immediately aft of the first watertight bulkhead is a sail locker extending 7-ft aft and sealed by a second watertight bulkhead 9-ft aft of the cutwater. The entire hull volume of this second compartment from 6" above loaded waterline is also a sealed compartment.

1.2.4. Similarly, each main engine room aft is separated from the accommodation by a watertight bulkhead.

1.2.5. The cabin soles of each hull are 4 to 6 inches above the loaded waterline. In each hull the volumes below the cabin soles are watertight compartments, excepting three sump areas provided for through hull fittings and bilge pumps. These below waterline sealed compartments are either sealed air space or integral fuel, water and holding tanks.

1.2.6. Sacrificial keels: Just aft of the forward watertight compartments are the leading edges of the E-glass/epoxy keels. These are constructed independently of the hull structure, such that penetration does not compromise the hull watertight integrity. The keels extend 12.5-ft aft and add 2-ft to the vessel's draft.

1.3. Dewatering

1.3.1. There are six 2200 GPH 24V centrifugal bilge pumps, three in each hull. Besides manual activation each pump is controlled automatically by an UltraSwitch magnetic reed relay water sensor. Activation of any of these bilge pumps sets an audible/visual alarm at the navigation station central annunciator panel, indicating which specific bilge pump is active. In addition the vessel carries a high-volume Edson manual pump mounted upon a foot board for use in dewatering any hull area. For information regarding the reliability of 24VDC electrical power for dewatering, please see the relevant section Electrical System Reliability.

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1.4. **Ground Tackle**

1.4.1. Anchor complement includes SPADE 2000 sq centimeter plow, Delta 88-lb plow permanently stowed on forebeam rollers. The Fortress FX-27 is stowed in the dedicated aft ground tackle locker. The Fortress FX-55 is stowed broken down in the forward ground tackle locker.

1.4.2. Two self-stowing forebeam rollers are fitted suitable for carrying their anchors in any sea conditions. Both forebeam anchor rollers are to permit securing the anchors against movement or loss in storm seas. The SPADE roller is above the forebeam to port of seagull striker, the Delta 88 roller is under the beam on centerline.

1.4.3. There are two Lofrans 24VDC vertical windlasses forward of the ground tackle locker, each normally rigged to the SPADE and Delta anchors for immediate deployment. Prior to each passage the starboard windlass is rerigged to manage the dedicated 24-ft parachute sea anchor rode of 600-ft of 3/4" New England Caprolan Nylon plus 50-ft of 3/8" high test ACCO chain.

1.4.4. The 24-foot diameter parachute sea anchor is stowed in a dedicated area of the deck locker forward of the mast ready for immediate deployment. A second, backup 24-ft parachute sea anchor is stored in the starboard sail locker. The Galerider drogue is stowed in a cockpit-area locker ready for easy deployment.

1.4.5. Chafe-free tangs are incorporated into the forebeam attachments to each hull for connection of bridles for anchoring or for sea anchor. Similar chafe-free tangs are incorporated into the after inboard cleat assemblies for connection of the aft bridle for use with either ground tackle or Galeride drogue.

1.4.6. The primary anchor chain locker will store 175 feet of 3/8 inch HT chain directly to and from the vertical windlass with no manual intervention. A separate adjacent rode locker will store the 200 feet of 3/4 inch nylon which is spliced to the chain. The combination rode is directed to the segregated rope/chain lockers via a custom stainless diverter gate.

1.4.7. 600 feet of 3/4 inch nylon rode spliced to 50 feet of 3/8 inch chain will be used both for the secondary anchor and the parachute anchor. This rode is stowed in a dedicated locker separate from the primary combination rode. A backup, new-unused 600-ft rode is stowed in the port sail locker.

1.4.8. 350 feet of 3/4 inch nylon rode with 15 feet of 3/8 inch chain will be used both for the stern anchor and the drogue. This rode and FX-27 are stowed in a purpose-built dedicated deck locker incorporated into the cockpit winch console.

1.5. **Fire Risks**

1.5.1. The vessel's machinery is concentrated in three spaces. The two propulsion engine rooms contain only the Yanmar diesels, hydraulic steering, and duplicate autopilots. The machinery space forward of the mast bulkhead contains the Fischer Panda 10kW genset, diesel hydronic heat including domestic hot water supply, Spectra watermaker, duplicate 24VDC Mastervolt 75A chargers, 3kW Mastervolt inverter, domestic pressure water system and 9kW shore power isolation transformer.

1.5.2. Each of these three spaces is protected by an automatic Kidde 241/FW150 (5.6 lbs of FE-241 agent) fire-fighting device, each of which is also provided with remote manual activation outside of the associated compartment.

1.5.3. Each of these three spaces is also equipped with a heat-sensing alarm device - which alarms either when the local temperature increases at an unusual rate (18°F/minute or

more), or when temperature exceeds 135°F. Each of the three heat sensors activates an identifying alarm condition at the central annunciator panel.

1.5.4. Manual fire extinguishers are sited outside and adjacent to all vessel spaces which have highest fire risk, such as galley and the three machinery spaces. In addition every crew-occuppied space is fitted with a manual extinguisher adjacent to the main exit. These dry chemical extinguishers are as follows:
- Four Kidde Type 3-A,40-B-C, 5lb
- Three Kidde Type 10-B-C, 2.8lb

1.5.5. Because fires of electrical origin are of particular concern, every effort has been undertaken to prevent such an event. Every centimeter of electrical cable is protected by a CPD (Circuit Protection Device) rated substantially below the ABYC engine-space ampacity rating of the cable. All cabling has been sized for minimal voltage drops, and installed in accordance with ABYC and New Zealand electrical codes and specifications. Virtually all electrical cable and terminations are highest quality marine grade supplied by Ancor USA. All cabling is further protected by conduit or industrial electrical ductings.

1.6. **Electrical System Reliability**

1.6.1. (see also Fuel System Reliability)

1.6.2. The vessel is equipped with 12VDC, 24VDC and 230VAC electrical systems. The design and installation of these systems has been undertaken to minimize insofar as possible the complete failure of each subsystem.

1.6.3. 24VDC subsystem: A 24V/360AH battery bank is sited on the bridgedeck under the navigation station, 1 meter above the DWL, and such that the batteries would remain above the flooded waterline should every one of the vessel's watertight compartments be compromised. This bank is comprised of two independent, normally-paralleled, 24VDC banks each containing four 6VDC East Penn gel batteries. Each of the two sub-banks is isolated by a 150A Blue Sea breaker located approximately 18 inches from the last battery terminal. All 24VDC battery bank cabling is 4/0 Ancor cable.

1.6.4. There are three independent 24VDC charging sources. Each of the two propulsion engines is fitted with an Electrodyne heavy-duty 70A alternator. The Fischer Panda genset supplies two independent Mastervolt 75A chargers.

1.6.5. 12VDC subsystem: Each of the three diesel engines is fitted with the factory-supplied 12VDC electrical system. Each engine's 12VDC alternator charges its own 12V/86AH East Penn gel battery (all three engine batteries are identical in the event one must be physically relocated to serve a higher priority function). In addition, three Mastervolt 20A DC/DC converters are supplied by the vessel's 24VDC system. These three converters supply respectively, SSB radio, navigation instrumentation and lighting. A four-source selector panel is installed at the navigation station which provides subsitution in the event of a fault of any of three 12VDC converters or of the genset alternator or battery. That is, any converter can be selected to supply power to any of the 12VDC consumers, including charging the genset battery in case of genset alternator failure. In the event of failure of all 24VDC charging sources, or of all three 24 to 12VDC converters, the genset battery/alternator can be selected for backup supply of all the 12VDC consumers.

1.7. **Autopilot Reliability**

1.7.1. Self-steering is important to passage-making safety because crew-fatigue induced by full time manual steering can contribute to human operating errors. To minimize the

possibility of autopilot failure the vessel is equipped with two completely redundant B&G Hydra pilots. Each pilot controls its own 24VDC, Size 3 hydraulic pump. These pumps are significantly oversized for the vessel's requirements, and are normally fitted upon 80-plus LOA monohulls or power vessels. Switching between the redundant pilots is accomplished by a heavy-duty selector switch. Should the primary Furuno pilot steering gyro-compass fail, the prewired backup B&G fluxgate compass can be substituted by simply switching terminations at the active pilot computer.

1.8. **Fuel System Reliability**

1.8.1. The reliability of the vessel's electrical systems is dependent upon the supply of quality diesel fuel to the three engines. Every effort has been undertaken to ensure the reliable supply of clean diesel fuel by means of the Fuel System.

1.8.2. The fuel supply is isolated in five tanks having a total capacity of 430 USGal. 400 USGal are stored in four integral epoxy tanks, two in each hull. Fuel is directly gravity-fed to all diesel consumers from a central 30 USGal "day tank" sited on the bridgedeck. The system is designed so that at least 20 hours of cruising speed operation can be supported by pristine fuel loaded in the central day tank.

1.8.3. Fuel filtration and transfer is controlled from a central Fuel System panel located on the bulkhead separating the workshop from the forward machinery space. The Fuel System is comprised of:

1.8.4. Three parallel, independent pumps. Two are 24VDC continuous-duty Shurflo 8000 series industrial pumps. The third is a diesel-rated manual Whale diaphragm pump.

1.8.5. Filtration is accomplished via two series-connected industrial grade high-volume filters. The first filter is an RCI Purifier RC 400-E centrifugal filter which removes at least 95% of free water and particulates. The second filter is a depth-type Gulf Coast Filters model F-1. This filter removes 99.9% of any free or emulsified water present, and all particulates larger than 0.5 microns at flow rates up to 2 USGal per minute.

1.8.6. Fuel can only be transferred between any of the vessel's five tanks by processing through the RCI and GCF filter manifold. The Fuel System valve manifold provides for fuel transfer from any of four hull tanks to any other and to the common day tank. The forward-starboard hull tank is also plumbed to the fuel manifold such that fuel can be loop-back polished through the filter manifold to this tank. New fuel loaded aboard is always isolated in this tank and is treated with Biobar and DFT#1500 to eliminate bacterial contamination. It is then tested and polished before transferring to another hull tank for storage. Onboard polishing can be accomplished either by loop-back polishing, or by transferring once between any pair of tanks via the RCI and GCF filter manifold.

1.8.7. To simplify refueling in remote areas, the Fuel System can also pump fuel from containers on a wharf or adjacent vessel.

1.8.8. Vessel operating procedures require that all onboard fuel except the daytank be recirculated through the filter manifold weekly.

1.8.9. The common day tank is managed by an automatic level control system. Two magnetic reed-switch float sensors start and stop day tank resupply at 75% and 95% full, respectively. The day tank can also be resupplied by manual override of the automatic system. In the event of failure of both Shurflo fuel transfer pumps, the day tank can be resupplied via the manual diaphragm pump. All fuel supplied from the day tank is filtered a third time via a Racor 500 FGSS2 filter with 2 micron element (60gph rating, approximately 30-times oversized). While this filter is intended to protect against any

small amounts of condensation in the day tank, it is also a third level of insurance of fuel quality.

1.8.10. To ensure that water does not enter any fuel tank in extreme sea conditions, each tank vent line is protected by a high-capacity water-separator which admits only dry air into the tank from vents located just below the sheer.

1.8.11. In summary, clean fuel supply is assured by preventing seawater and bacterial contamination, by immediate onboard polishing of all new fuel, by weekly repolishing of every tank, and by processing all fuel through three filtration stages before the fuel reaches each engine's factory fuel filter.

1.9. **Central Annunciator Panel**

1.9.1. To minimize reaction time to any onboard event which might threaten the vessel or crew, all abnormal condition alarms are managed by a central annunciator panel installed at the primary inside steering station/navigation station situated just to port of the mainmast on the bridgedeck. Any such alarm indication illuminates a indicator identifying the source, and activates a piezo-electric audible alarm. This alarm may be manually silenced, but the visible indication can only be cleared by correcting the associated fault. The fault indicators are as follows:

1.9.2. For both Yanmar propulsion engines and Fischer Panda genset:
- seawater cooling flow rate (each engine is fitted with an independent flow sensor)
- oil pressure
- engine overheat
- saildrive leak

1.9.3. For each capsize escape hatch, one port, one starboard - hatch is open when any propulsion engine has ignition feed

1.9.4. For the three engine/machinery spaces - heat sensor alarm condition

1.9.5. For each of six automatic bilge pumps - indication of specific pump active

1.9.6. ALERT man overboard receiver - indicates the crew transmitter has been immersed in water

1.9.7. Instrumentation alerts
- Radar
- GPS
- B&G Hydra System (water depth, etc.)
- Autopilot fault

1.10. **Lightning Protection System (LPS)**

1.10.1. The LPS is designed and installed in accordance with ABYC specifications, and in consultation with Dr. Ewen M. Thomson, University of Florida Lighting Research Laboratory, author of "A Critical Assessment of the U.S. Code for Lightning Protection of Boats", IEEE Transactions on Electromagnetic Compatibility, Vol 33, No.2, May 1991, which article is the basis for the 1994 upgrading of the ABYC specification.

1.10.2. The primarily-vertical downcondutor system begins with a masthead air terminal extending well above the masthead instrumentation and VHF antenna. The mast base is connected to the primary down-conductor via a 10mm aluminum rod, which is then joined by a bimetallic Al/Cu crimp connector to a short length of AWG#4 Ancor battery cable, thence via a copper plate sandwich to the 6" copper foil LPS ground which is bonded inside the vessel wing and hull as it travels smoothly down to the starboard keel

ground. The starboard and port shroud chainplates are similarly connected to 6" copper foil which join at the respective keel grounds. Each keel ground is comprised of 6" copper encircling each keel for 340 degrees just below the hull-keel junction.

1.10.3. The primarily-horizontal bonding system is designed to protect the crew from delta-V developing between any metallic conductors. These are the steering controls, lifelines and pulpits, winches, windlasses and engines.

1.10.4. The navigation electronics are further protected by transient suppression devices. All supplied power is via equal-length, twisted-pair cabling. At both ends of all such supply cables, nanosecond response Trans-Zorb devices are connected from both positive and negative leads to the LPS ground. Instrument sensors such as boat speed, depth and wind system are similarly protected. The primary VHF radio is further protected by a gas-discharge arrestor in the masthead antenna lead.

1.10.5. A direct lightning strike can involve currents as high as 100,000 amperes. In such an event the LPS and transient suppression offer no guarantee of survival of electronics. Therefore backup GPS and VHF radios are stored in an aluminum enclosure (Zero Halliburton case) stowed as far from the mast and shrouds as possible.

1.11. **Reliability of communications**

1.11.1. VHF radio - the primary VHF radio is supplemented by two handheld VHF radios, one of which is always stored in an aluminum enclosure to improve survival in a lightning induced EMF event. The primary masthead VHF antenna is supplemented by a backup, prewired 6-ft whip antenna supported on the aft radar arch.

1.11.2. SSB HF radio

1.11.3. Inmarsat-C transceiver- Trimble Galaxy with integral GPS position reporting

1.12. **Reliability of GPS positioning information**

1.12.1. There are four GPS receivers. The primary GPS is the Garmin 128 with antenna mounted on the radar arch. The secondary GPS source is the Trimble Galaxy Inmarsat-C. The third and fourth backup GPS are Garmin handheld units, one of which is always stored in an aluminum enclosure to reduce the risk of damage from lightning-induced fields.

2. **GENERAL**

2.1. The Builder shall construct, equip and furnish a yacht to be mutually discussed and understood between Owner and Builder prior to execution of the construction contract.

2.2. The attached Weight Analysis provides a detailed bill of material for the yacht, and is to be considered an integral part of this Specification. Different manufacturer and model numbers may be substituted if or equivalent or higher suitability and quality.

2.3. All major articles of equipment to be supplied by the Owner are specifically itemized in the section *Owner-Supplied Equipment*. All minor fittings and hardware appropriate to a first-class yacht for the proper installation and operation of the yacht's joiner work, equipment, systems and sail handling as described in the Schedule C Preliminary Plans and/or Schedule B Specifications shall be provided by the Builder. Except for such items of equipment as are specifically included in the section *Owner-Supplied Equipment*., the Builder shall furnish all items which are appropriate or necessary for the proper operation of the yacht as an auxiliary sailing vessel in exposed waters. All materials and manufactured articles of construction and equipment are to be of the best quality for their respective purposes.

2.4. Unless specifically noted as Owner supplied, items not mentioned in the plans and specifications but which are normally considered as sound marine practice shall be included in the vessel.

3. GENERAL CONSTRUCTION

3.1. Every effort shall be undertaken to ensure that the Architect's weight specifications are achieved.

3.2. A test panel of the typical hull laminate schedule to be constructed, measured for thickness to validate plan offsets, and weighed to validate the Architect's weight specifications can be achieved before construction commences.

3.3. Secondary bonds and other structural bond methods to be approved by Architect.

3.4. Lifting point/cleats (4) are to be provided and installed on structural bulkheads per the Architect. A four point lifting sling capable of lifting the entire boat with its equipment is to be provided by the Builder. The sling is to be wire rope construction to commercial standards. Suitable stowage to be provided for the lifting sling.

4. ACCESS TO COMPARTMENTS

4.1. Arrangements for access and for cleaning out and painting shall be provided to all compartments and to all parts of the vessel wherever practical.

4.2. Access to the engine, steering gear and all other equipment that may require services of any kind shall be provided by developing joiner work, etc., which can be removed for convenient access.

5. BILGE PUMPING

5.1. In general, powered and manual pumping arrangements to be provided suitable for a bluewater vessel of this type, ensuring that every compartment can be dewatered effectively in heavy weather conditions.

5.2. A separate manual high volume bilge pump will be used for dewatering the small remaining sumps between integral tanks..

5.3. Submersible electric bilge pumps will be fitted in each engine room and each main hull sump.

6. CAPSIZE PROVISIONS

6.1. All of the vessel's equipment, joiner and fittings shall be secured to ensure there is no movement in the event of vessel capsize.

6.2. Waste, water and fuel tanks all to be plumbed to ensure that fluids do not leak after capsize.

6.2.1. Fresh water and diesel tank vents shall be fitted with ball-valves to prevent loss of water or fuel supply thru the vent lines.

6.3. The battery system to be located, installed and secured such that when capsized at least 200 amp hours of capacity is still available for emergency use. Suitable disconnects to be provided to ensure that current does not flow in wiring or systems which may be submerged after capsize.

6.4. Water tanks to be fitted with a suitable means for accessing remaining supplies when capsized.

6.5. Fittings to be provided for attachment of suitable sleeping nets for 4 crew.

6.6. The arrangement of safety equipment, food stores, and cooking facilities shall permit reasonable access after capsize. The propane bottles will be either usable inverted, or movable to a secure location to permit usage of an emergency propane burner.

6.7. Underwing fittings to be provided to secure a suitable International Orange distress signal covering the underwing area.

6.8. Suitable attachments to be provided to allow the crew to rig safety lines and handholds to permit safe movement around the capsized vessel, including entering/exiting the interior.

6.9. A secure and effective-for-transmission location is to be provided to fit a 406 EPIRB on the inverted vessel. This EPIRB can be utilized to locate the capsized vessel before or after the crew abandons the vessel.

6.10. Two escape hatches are to be fitted in the underwing chamfer panel. The starboard hatch is located between the end of the owner stateroom berth and the bureau. The port hatch is located under the stairway with provision for clearing the stair steps in the event the hatch must be opened from the hull side. Both hatches are to be guaranteed from water ingress by suitable fairing to ensure waves do not compromise the watertight integrity of the hatch.

7. DECK AND HOUSE CONSTRUCTION

7.1. Laminate schedule (see Drawing SD52043)

7.2. Deck to be finished with suitable non-skid surface with smooth finish trim around hatches, sheer line, deck hardware etc.

7.3. Salon windows are to be tempered glass — material specifications and installation details to be supplied by Architect.

7.4. Salon-to-cockpit doors and windows are tempered glass, with horizontal slide mechanisms — material specifications and installation details to be supplied by Architect.

7.5. Each transom to be fitted with an horizontal locker suitable for stowage of one standard size dive bottle.

7.6. All externally accessible lockers to be either fitted with robust locks, or locked from the interior.

8. DECK HARDWARE

8.1. Lifeline stanchions and bow/stern rails are all 42 inches tall with triple wires. Stanchions are to be epoxy composite, to be fitted in strong molded flush deck recesses.

8.2. Bow, stern and midship bollards, or equivalent, are to be fitted and of sufficient strength to be suitable for hurricane-mooring of the vessel to the anchors and other available rode attachments.

8.3. Stainless steel handholds are to be provided along the cabin sides and other locations as required to ensure the crew can transit from cockpit to foredeck without leaving a handhold.

8.4. The coachroof stainless handrail continues, wrapping around the front windows to support the "eyebrow" awning, while also providing a handrails up the windows in the way of the mast.

8.5. Outboard of the 1" coachroof handrail tube is a 3/8" solid stainless rod to serve as a rigidly-mounted jackline.

8.6. Rub rails to be UHMW synthetic extrusions with the top surface shaped to lead deck runoff aft to transom.

8.7. Deck hatches fitted over the bow and engine watertight compartments, and over the foredeck lockers and machinery space shall all remain watertight when the vessel is capsized to ensure the buoyancy of these compartments is not compromised.

8.8. All hatches, sliding doors/windows and opening ports to be fitted with tight-fitting insect screens. Deck hatches to be fitted with spring-retrieve, tight-fitting roller insect screens. Cockpit door to be fitted with removable, tight-fitting screen door.

8.9. The stateroom and salon deck hatches are to be fitted with removable Sunbrella covers designed to both capture ventilation air, and to shield the hatch opening from rain or spray and rain-splash from the deck.

8.10. Telescoping 4-step swim ladder to be fitted to stbd transom, recessed into the large bottom transom step, and secured to prevent accidental deployment by a wave strike. Provision must also be made for easy deployment of the ladder from the water.

8.11. A modified Nova-Lift 2 deck crane will be provided, with integral deck sockets near both foredeck lockers. The deck crane will be removable, normally stowed in a bow locker.

8.12. Lifting tasks aft are handled by the tender lifting system.

9. **GROUNDING AND BONDING**

9.1. Lightning protection and bonding system to be installed according to best international practice. The primary lightning ground and SSB ground plane will be a 6" wide copper foil, .005" thick, laminated to the structure leading from sheer to sheer in the plane of the mast. The general design approach is a mainly-vertical low-inductance lightning ground system connecting mast and shrouds, and a separate mainly-horizontal bonding system which connects the negative DC ground to all large metal items, and makes seawater contact via the engines. The systems are as orthogonal as possible to minimize EMF coupling from the lightning ground into the bonding ground. The lightning ground is further isolated from the DC ground by a high-voltage capacitor DC-block to minimize electrolysis problems. The masthead is fitted with an air terminal lightning rod of approximately 36-inch height to protect the masthead instruments. If the mast is carbon fiber, then the lightning strike is to be conducted via a #4 AWG or larger tinned copper cable to the mast base ground connection.

9.2. The 12VDC supply wiring is all to be done with equal-length twisted-pair or Ancor jacketed-pair-cable to minimize differential EMF-voltages between plus and minus leads. At both ends of each supply run to sensitive items such as electronics, Tranzorbs are installed across the +/- leads to clamp the plus side to ground voltage. All antenna leads are protected by coax arrestors and ferrite sleeves.

9.3. All instrument sensors, such as depth, speed, AWA, AWS are wired with twisted-pair and protected by ferrite sleeves.

9.4. The navigation station main electronics installation to be electromagnetically shielded with copper foil, including the lining of a tambour door which can be closed to shield the electronics from either spray or lightning induced currents.

9.5. Energy budget —see attached Schedule F.

9.6. DC charging system —see attached schematic.

9.7. Interior lighting to be primarily halogen with indirect lighting where appropriate to provide ambient background illumination.

10. ELECTRICAL SYSTEM

10.1. 12/24 VDC, 230 VAC electrical and electronic systems — components are specified in the Bill of Material database. All connections, terminals and wire sizes are specified in the Conductors and Circuits databases.

10.2. The design and installation of the electrical system is to ensure that it is nearly impossible to lose either 12V or 24V supplies adequate for safe operation of the vessel. With regard to the electrical system, the only allowable common-mode failure is diesel fuel contamination. Prevention of this failure mode is addressed in the Fuel System Specification.

10.3. Fire Prevention

10.3.1. Every effort shall be undertaken to eliminate the possibility of an electrical fire. Every conductor shall be protected by a suitable CPD (Circuit Protection Device) except where in special circumstances the conductors can be physically isolated such as to guarantee no possibility of a fault. All CPDs are Blue Sea Systems, and must be positioned for quick access/operation or replacement.

10.3.2. Every engine battery can be isolated via a battery disconnect switch located outside of the corresponding engine space.

10.4. All wiring to be run in conduit or equivalent ducting. Harnesses must be removable for replacement or repair. Service loops shall be provided at all equipment to facilitate access and repair, with suitable provisions to protect wire and terminations where vibration or movement is possible.

10.5. All wire is to be marine grade tinned wire, Ancor or equivalent. Terminations to be die-crimped with tinned marine grade terminals, Ancor or equivalent.

10.6. Where possible, connections are to be avoided in areas which could reasonably be expected to be wet, such as bilges. If not avoidable, e.g., sump pumps supplied with short pigtails, connections shall be made via Ancor adhesive-lined shrink tubing terminations - usually butt connectors.

10.7. All panels and terminal blocks to be protected from possible water incursion from rain or spray entering through normal openings such as hatches, windows or doors, or from leaks developing around fittings attached to the vessel.

10.8. All wires are to be clearly labeled in correspondence to the vessel Wire List at each end where the wire terminates in a mechanical connection.

10.9. Machinery space — because the only access is via a deck hatch, no breakers or fuses or any equipment required for safe operation of the vessel are to be located in this space.

10.10. To facilitate replacement and repair, all pumps are to be wired with ring terminals to an adjacent terminal block. Ensure that the length of the leads of same-type pumps is nearly equal so that the pumps can be quickly interchanged.

10.11. Alternator regulation — a single CE In-Charge regulator controls the field of both 24V Electrodyne alternators.

10.11.1. The field current is a pulse-width modulated signal, so when running the long lead across to other hull RF interference is a real possibility. The field leads shall be fully shielded, maybe use twisted pair as well (not clear to me whether twisted pair helps).

10.11.2. The primary regulator failure mode is due to transients, which may result in damage to the internal tranzorbs, which will fail either open or to a short. Replacing these is field

repairable. For extra protection we may wish to install another pair of tranzorbs externally.

10.12. Refrigeration

10.12.1. Glacier Bay DC Controller — Pin 18, Engine Start Input 12V Positive - trigger this line when either 24V alternators or 24 chargers are active. This control short-cycles plate freeze down.

10.13. Yanmar Engines

10.13.1. The maximum allowable resistance for each engine battery wiring loop is 0.0012ohms, which requires AWG 4/0 cable for our loop lengths of 20 and 16 ft, stb and port.

10.14. Grounding Scheme

10.14.1. The ship's DC ground is only via the saildrives — the saildrives are the only underwater metal to be DC-connected. The primary lightning ground down conductors connect the mast and shrouds via 6" wide copper strap to both port/starboard keel grounds. The lightning bonding scheme is intended to minimize the delta-V between any conductors which the crew may contact (lifelines, winches, windlasses, engines, etc.) — it is implemented via the ship's DC ground bus which is connected via a DC-block at a convenient location near the starboard keel down conductor.

10.14.2. The ship's RF ground also utilizes the engines, lifelines and the port keel ground, as well as a 50 sq.Ft. copper foil laminated under the port aft cabin sole. The antenna RF ground is connected to engines, etc. via a DC-block.

10.14.3. Installation must ensure that an unintended DC connection is **not** made via the mast. Therefore the VHF antenna must be DC-isolated via an inner-outer block. All other mast mounted electrical equipment must be DC-isolated from the mast as required.

10.15. 24VDC supply

10.15.1. The vessel's primary DC power is 24V, supplied by an East Penn 360AH bank which is comprised of eight 6V/180AH gel cells.

10.15.2. The primary 24V charging system is via two Mastervolt 75A chargers. These are to be installed to enable quick isolation of either charger in the event of failure.

10.15.3. The secondary 24V charging system is via two Electrodyne 70A alternators driven by each Yanmar saildrive. Both alternators are regulated by a Heart Link 2000R battery monitor/regulator. These are to be installed to enable quick isolation of either alternator in the event of failure. Each alternator is enabled by the respective saildrive oil pressure sender to avoid loading the engine before it is up to speed.

10.16. 12VDC supply

10.16.1. 12V power is required for most of the navigation electronics, VHF, SSB and stereo. All three engines are also operated in standard 12V mode as supplied by Yanmar/Panda.

10.16.2. The primary 12V supply is via a Mastervolt 24V/12V DC/DC converter capable of 20A continuous supply at 12V. This converter is buffered via the genset 12V battery for short term peaks exceeding 20A.

10.16.3. To ensure 12V supply adequate for safe operation, any of the four 12V sources can be manually selected onto the 12V bus:

10.16.3.1. DC/DC converter

10.16.3.2. Genset battery

10.16.3.3. Port saildrive battery
10.16.3.4. Starboard saildrive battery

10.16.4. To avoid heavy cabling from the engine rooms to nav station, the midship 12V sources CANNOT be used as alternate saildrive starting batteries. However, either saildrive battery can be paralleled to allow starting the opposite engine.

10.17. 230VAC/50Hz supply

10.17.1. There are three 230V sources:
10.17.1.1. 10kW Panda genset
10.17.1.2. 3.5kW Mastervolt modified sine wave inverter, 2.5kW continuous rating.
10.17.1.3. Shore Power via 9kW isolation transformer with step up windings from 115 to 230VAC, and secondary -5%, -10%, -20% under-voltage taps.

10.17.2. Shore power is fed from starboard near the machinery space directly to the 2-pole AC breaker thence to the isolation transformer. Suitable provision is to be made to switch to step up operation. The ship's AC ground is connected to the ship side Neutral winding.

10.17.3. A Blue Sea three-source selector/breaker (with lockout) is used to choose the single AC supply.

11. FUEL TANKS

11.1. There are four fuel tanks, approximately 400 gallons total, and one 30 gallon daytank. Both engines and genset will be fed only from the daytank, and all return lines will be lead only to the daytank.

11.2. Fuel tanks shall meet all minimum requirements for ABS and shall be installed as integral epoxy laminates.

11.3. Fuel tanks shall be filled with vertical baffle plates at intervals not exceeding 30 inches. Baffle plates shall be of the same material as the tank and shall be connected to the tank walls by welding.

11.4. Fuel tanks shall be installed to permit easy access for examination and testing. The tanks shall be adequately supported and braced to prevent movement — including capsize of the vessel. The supports and braces shall be insulated from contact with the tank surfaces with a non-absorbent material.

11.5. Fuel tanks shall be tested to a pressure of 5 pounds per square inch or 1.5 times the maximum load to which they may be subjected in service, whichever is greater.

11.6. Fuel tanks shall be fitted with suitable sumps for collection of water and debris, and with pumpout lines led to the sump bottom.

11.7. Fuel lines shall be accessible, protected from mechanical injury, and effectively secured against excessive movement and vibration by the use of plastic straps on 12 inch centers. Where passing through bulkheads, fuel lines shall be protected by close fitting ferrules or stuffing boxes.

11.8. Fuel shut-off and transfer valves shall be of the bronze stainless ball type such as those manufactured by Conbraco, or equal. Size shall be determined by the fuel line size and shall be fitted in the fuel supply lines and return lines, one valve at each tank connection, one at each fuel manifold connection, and one at each engine connection to stop fuel flow when servicing accessories.

11.9. Fuel tank vent lines are to be installed so as to ensure seawater cannot enter the tanks via the vent lines.

11.10. Fuel tank fill lines to be fitted with suitable and accessible valves just below deck level to ensure seawater does not enter the tanks via the fill lines.

11.11. The tanks shall be removable for service or replacement without disassembly of the joinerwork.

12. **FUEL TRANSFER SYSTEM**

12.1. See attached Schedule I schematic.

12.2. Fuel can be transferred among any of the five tanks via the primary filter system. New fuel can be inspected and pre-filtered by loopback through the filter assembly to the tank that is being loaded.

12.3. Only one filter and transfer complex is needed for all three engines. Estimated max. flow rate for all 3 engines using the Max HP/60 = max. fuel rate, including the fuel that will be returned, is 10.7 GPH. Each filter fitted with vacuum gauge.

12.4. The transfer pumps are to be the Shurflo 8000 series industrial pumps plumbed and valved in parallel for instant backup. A Whale manual diaphragm pump with Nitrile elastomers is also plumbed in parallel for backup. It is assumed that the engine/genset lift pumps, have the capacity to lift the 18 to 24" needed to lift the fuel from bottom of daytank into the filters. The same pump unit is used for oil changing providing common spare parts.

12.5. Easily accessible duplex primary fuel filters are to be fitted in the machinery space near the daytank, including suitable drip tray to contain fuel when filters are changed.

12.6. The fuel transfer manifold/pump assembly and the filter subsystem to be mounted on the shop bulkhead adjacent to the machinery space.

12.7. Automatic level sensing on the day tank controls start/stop of transfer pumping.

13. **HULL CONSTRUCTION**

13.1. Laminate schedule (see Drawing SD52020).

13.2. Builder to submit Specifications for resin system to be used to the Architect for approval.

13.3. Exterior of hull to be faired to within +/- 2.5 mm of the designed shape, primed, and painted with manufacturer's recommended preparation system and two coats of 2 pot linear polyurethane - one color of Owner choice topsides, epoxy bottom preparation applied per manufacturers Specifications on the bottom.

13.4. Interior of hull to be one color 2 pot polyurethane finish of Owner's choice. Extent of interior hull fairing material to be minimal.

14. **INTERIOR & JOINERWORK**

14.1. The interior finishes are to be styled to provide a bright, open appearance. The bulkhead, ceiling and wall surfaces shall be painted in white polyurethane. Hardwood trim will be utilized for accents. Joiner which would normally be expected to be wood construction shall be either veneer or hardwood. Doors and drawer fronts throughout shall be finished in suitable hardwoods.

14.2. All locker/cabinet doors to be fitted with louvers or other appropriate method to ensure adequate ventilation. Similarly, all interior lockers shall have adequate ventilation ports on all sides as practicable.

14.3. All interior lockers or drawers to be fitted with push-button latches or other means to ensure closure in the event of violent accelerations in severe weather.

14.4. The dining table and navigation station work surface shall be finished in a suitable hardwood. One or more chart stowage drawers are to be fitted underneath the dining table. Horizontal surface of table to be cored for stiffness and light weight.

14.5. The galley and dish cabinet countertops are finished in Granit 90, and head countertops shall be finished in gloss white lacquer.

14.6. The salon cabin sole shall be finished in 4 to 6 mm hardwood. The selected hardwoods will provide contrasting light/dark colors similar to traditional "teak and holly soles". The sole is to be radiused at the interfaces with bulkheads and joiner to facilitate cleaning. The sole shall be finished in two pot polyurethane with anti slip granules applied in the appropriate areas.

14.7. The hull cabin soles shall be finished in two pot polyurethane of suitable color. The soles are to be radiused at the interfaces with bulkheads and joiner to facilitate cleaning and carpet vacuuming. All undersole compartments to be watertight and fitted with suitable watertight inspection ports flush with the sole —such ports to remain watertight when the compartment is flooded. Owner-selected carpet shall be installed over the soles and conformed to the sole-edge radiuses to facilitate vacuuming.

14.8. All joinerwork to be in accordance with the best yacht practice. Where particular sizes are not called out by specification or drawing, material should be as light as is consistent with good practice. Builder to check in advance with all material used. Corners of all hatches, bulkheads, seats, partitions, etc. to be well rounded.

14.9. Salon windows shall have privacy/sun shades installed of the accordian-fold synthetics. Exterior removable sun-shade mesh coverings to be fitted for all salon windows. Salon windows to have sofits to conceal indirect lighting and shade mechanism.

14.10. Clear sight lines, at the owners' heights, are required from the salon settee and nav station seating through forward and side windows. It may prove necessary to elevate the salon sole and seating by 2" to 4" to accomplish good visibility.

14.11. The portside workshop is to be fitted with a suitable workbench top, including vise fittings. Suitable drawers and bins to be provided for stowage of tools and spare parts.

14.12. The owners' stateroom is to have a large mirror fitted to the aft bulkhead to visually enlarge the space. Full-length bookshelves are fitted on both inboard/outboard sides of the standard queen-size berth. Small "nightstand" surfaces are to be provided both sides at the forward end of the berth. Every effort will be made to ensure excellent ventilation for the cabin and particularly the berth area at anchor.

14.13. Lee cloths to be provided for port aft berths.

15. MATERIALS

15.1. Stainless steel shall be 304 or 316.

15.2. Aluminum to be 6061-T6 or 5086-H32 as indicated on drawings.

15.3. All wood to be quartersawn, dressed on all sides, and free of sap pockets, checks knots and other defects. A moisture content of 12% is recommended.

15.4. Plywood to be best waterproof exterior type. 1/4" and under to be 3 ply: 3/8" and over to be 5 ply. Plywood that is to be natural finished to have thin rift cut oak veneer on surface.

16. OWNER-SUPPLIED EQUIPMENT

16.1. The equipment and material itemized below shall be obtained by the Owner and, if sent to the Builder, shall be installed and tested by the Builder with all necessary foundation, connections

and related equipment.

16.2. The Builder shall be responsible for the safe-keeping, in an area accessible to the Owner, of all Owner's items sent to the Builder. The Owner shall inform the Builder of the value of such items. Such items are to be covered by the Builder's Insurance Policy.

16.3. Owner shall supply the following items:

- Electronics, lighting and electrical equipment
- Engines, engine controls and propellers
- Genset
- Ground tackle, anchors, rodes and windlass
- Hydraulic steering pumpsets, valves and cylinders
- Major air conditioning equipment
- Safety gear and other miscellaneous equipment required to furnish a fully found yacht
- Sails
- Spars, standing and running rigging
- Watermaker, plumbing and pump equipment
- Winches and deck gear

17. **PAINTING AND FINISHES**

17.1. Fairing and painting is to be of the highest standard throughout. All interior corners, junctions and surfaces are to be suitably radiused and smooth to facilitate cleaning.

17.2. Paint is to be spray finished. Interior varnish work is to be hand rubbed and external surfaces finished gloss.

17.3. Where feasible the finish is to be a complete paint system, and the compatibility of one preparation with another is to be assured.

17.4. The inside of the hull is to be completely painted throughout, before any fitting out is started.

17.5. Topsides to be painted with linear polyurethane paint, Awlgrip color Snow White. Paint scheme to include light topside color, one boot top, and one cove stripe all of Owner's choice of color. Name to be painted on each side conforming to Owner's graphics design and hailing port to be painted on transom.

17.6. Deck to be painted with light colored LPU, Awlgrip color Snow White, with contrasting non-skid. Colors to be of Owner's choice.

17.7. The below water-line finish is to be fair and smooth. The bottom is to be coated with Epiglass Barrier, International Micron 25 or similar non-metallic antifouling in accordance with local environmental protection legislation.

17.8. The Owner is to provide the final color schemes for the exterior and interior.

18. **PLUMBING**

18.1. Special care to be taken when laying out and routing plumbing so that it is neat and orderly. All valves, drains, etc. to be made readily accessible and with protective collars at all points where piping might touch the ships structure. Builder to supply accurate plumbing diagram to Owner.

18.2. Water and holding tanks shall be integral epoxy-laminated, fitted with suitable baffles and cleanout plates, and shall be accessible for service or replacement without major disassembly of the joinerwork.

18.3. All waste, water and fuel tanks are fitted with Tank Tender level sensors.

18.4. Owner to provide specifications for fresh, salt and black water hoses.

18.5. Each of the two heads are to be fitted with Sealand vacuum toilets.

18.6. A pressure fresh water system to be fitted with pressure pumps located in each hull. A cross-over line between port and stbd tanks, with suitable valves at pumps allows transferring fresh water between tanks.

18.7. The hot water tank will be heated by either genset coolant or AC power or by diesel boiler.

18.8. Both showers and galley sink are to be fitted with hot-water return line and suitable valve for circulating hot water to the point of use.

18.9. Showers to have sump and electric pump for discharge.

18.10. Galley to have additional foot pump for cold water.

18.11. Each head to have a mirror. Approximately 18 in. X 24 in. X 1/8 in. thick. Mirrors to have wood frame.

18.12. Each head to have counter with wash basin, faucet, appropriate towel bars and toilet paper holders. All fixtures to be approved by Owner.

18.13. The watermaker high pressure pump to be fitted with "T" valve feeding a ground tackle and deck washdown facility.

18.14. Washdown will also be provided via a saltwater outlet with Rule 3000 G.P.H. pump or equivalent.

18.15. A deck shower is to be fitted in the cockpit or transom area.

18.16. Heating will be provided either by the reverse-cycle A/C units, or by diesel-fired forced air.

18.17. Three aluminum propane bottles to be fitted with all propane gas plumbing to highest marine standards. The propane bottle locker to drain safely overboard, and to remain dry regardless of spray and wave strikes. Propane is to be supplied to both galley and cockpit-mounted barbeque. Propane detection alarms to be fitted in both hulls.

19. **ENGINES & GENSET**

19.1. Engines are to be Yanmar 3JH2-TCE diesel saildrives port and starboard. See Drawing SD52700 for installation particulars using the Yanmar-supplied fiberglass engine bed.

19.2. Engine controls shall be electronic, by Morse Controls, installed at inside steering stations. A second set of twin-engine controls shall be assembled into a portable module with pilot joystick - to be temporarily fitted to dorades at each side of cockpit for close-quarters handling.

19.3. Yanmar-supplied engine instruments and start/kill controls shall be installed only at the main cockpit steering station.

19.4. Engines to be fitted with wet-exhaust systems plumbed to ensure that it is impossible for following seas to force seawater into the engines.

19.5. Waterlift silencers to be separated from the hull by suitable vibration isolation mounts.

19.6. Fire control

19.6.1. Each engine room to be fitted with remotely activated Halon-type extinguishers, and temperature sensing alarms (at much lower temperature than the usual "melt-down" automatic extinguisher triggers).

19.6.2. Each engine to be fitted with remote air-supply aborts to ensure engine does not ingest the Halon. Alternately we may find a simpler way to make the fuel solenoid kill function fail-safe.

19.7. Engine room vents to be arranged to prevent water ingress.

19.8. Both propulsion engines and genset are to be fitted with Gulf Coast Filters 01-JR oil bypass filters.

19.9. The 10kW genset shall be installed per best marine practice in the forward machinery space. The Builder will take particular care to ensure minimum vibration is transmitted to the hulls and structure, that the wet exhaust system achieves the quietest operation available today, and that airborne noise levels are less than 50 db in the vessel interior. Genset to be provided with required silenced airflow in the machinery space, which airflow is secure against seas impacting the deck and underwing. The Genset wet exhaust will be process through a water/gas separator, with the water flow ejected below starboard hull waterline, and gas exhausted on the outside starboard hull near transom.

19.10. The forward machinery space and both engine rooms are to be lined with 1" lead/foam sound shield. The saloon side of machinery space bulkhead to be lined with 6mm high density barrier.

20. **MACHINERY SPACE**

20.1. Genset

20.2. Two 24V, MasterVolt chargers

20.3. MasterVolt inverter

20.4. Two 20amp 24V to 12V DC-DC converters

20.5. Isolation transformer

20.6. Spectra watermaker

20.7. Diesel heater

20.8. Daytank

20.9. Fresh water system

21. **REFRIGERATION**

21.1. See Schedule J — Refrigeration Engineering, and Schedule K — Refrigeration/Galley Drawing.

21.2. The refrigerator is 10.1 cu. ft. net of 1" Barrier 20 vacuum panel insulation. The minimum holdover time in 80°F water, 85°F ambient is to be 28 hours. One Glacier Bay eutectic holding plate is mounted on the outboard box wall. The inboard hinged door swings into the galley. The outboard hinged door swings into the passage to the port hull. A countertop lid provides access to frequently accessed liquids such as water. All openings are double insulated. Where feasible sliding drawers with solid fronts on rollers are utilized to minimize heat gain.

21.3. The freezer is 6.4 cu. ft. net of 1.5" Barrier 30 insulation. The minimum holdover time in 80°F water, 85°F ambient is to be 31 hours. Two Glacier Bay eutectic holding plates are mounted on the top box wall. The front-opening doors are double insulated. Where feasible sliding drawers with solid fronts on rollers are utilized to minimize heat gain.

21.4. The 1 HP Glacier Bay direct-drive refrigeration compressor is driven by 24VDC power. Refrigeration components are mounted in the cabinet adjacent to the freezer.

22. **AIR CONDITIONING**

22.1. Air conditioning will be fitted as per the attached schematics. There are two self-contained 16,000 BTU 230VAC units, and two 8,000 BTU Artic Air units supplied by the Glacier Bay 24VDC compressor — each fitted with ducting & air-handling valves to control the volume of cooling air directed to each of the adjacent zones.

23. **MAST STEP**

23.1. The mast bulkhead is designed to carry the full mast compression load. The purpose of the forward longitudinal web is to ensure the mast bulkhead remains in column. The mast bulkhead is further restrained in column by the adjacent anchor locker and machinery space bulkhead.

23.2. Mast Step

23.2.1. It is important to ensure the deck under the mast step is compatible with the mast supplier's mast step/base. No mast step fasteners are to penetrate the unidirectional reinforcements.

23.2.2. The centerline of the mast section is to be positioned coincident with the centerline of the mast bulkhead.

23.2.3. The mast step is to through-bolted to threaded holes in a 1/2" to 3/4" thick aluminum backing plate.

23.2.4. The top deck skin is to be reinforced in the area of the mast step and backing plate by means of two layers of DB340 laminate.

24. **RIG**

24.1. The rig shall be as specified in the Preliminary Drawings, utilizing the Reef-Rite mainsail boom furling system.

24.2. All sail handling controls are led aft to the cockpit winches and stoppers. Most of these lines will be led down through the foredeck at the main bulkhead, aft under the underwing, and up into the cockpit winch areas.

24.3. The solent jib is fitted on a suitable roller furling system.

24.4. The reacher is fitted on a removable light furler which is attached at the tack to a SS bridle and roller at the bows.

24.5. Suitable bridle attachment points and mast tang are to be provided for an intermediate staysail stay. This stay will not be initially fitted.

25. **RUDDERS & STEERING**

25.1. Hydraulic steering system to be installed per best practice. The primary steering station near centerline in the Navigation Station area. Completely redundant dual B&G Hydra autopilots are to be fitted. Both autopilot pump sets are installed in the port engine space.

25.2. Rudder shafts to have provision for attachment of the bronze tillers for attachment of the hydraulic rams.

25.3. Advanced Composites carbon rudder bearings at the top and bottom of the carbon rudder shaft are to be installed per the manufacturers recommendations.

25.4. Emergency steering — Top of the starboard rudder shaft to have provision for tiller steering with the alloy tiller operable from the cockpit.

26. **TENDERS**

26.1. A 12.5-ft custom power-catamaran tender will be stowed upright, including Yanmar 25hp outboard, on the after deck. Appropriate launching and retrieval tackle to be provided to facilitate operation by a single crew. Stowage chocks and robust tiedowns to be provided to secure dinghy and cover with outboard and fuel tank mounted, suitable to protect dinghy under boarding sea impact. When stowed for passage, the tender is protected by a suitable cover provided with a robust means to ensure the cover drains completely and rapidly, which cover is also lashed to deck fittings.

26.2. Suitable stowage for a secondary inflatable dinghy to be provided in the starboard bow locker or other suitable location. Suitable secure, convenient stowage is to be provided for the 3.5HP secondary dinghy outboard.