THE PATHFINDER
OFFSHORE 45
PIERA

I story **PETER BRADY** images **JONATHAN WOOD**

As promised, part two of *Piera's* story explains the background to her design, construction and systems in more detail.

THE DESIGN

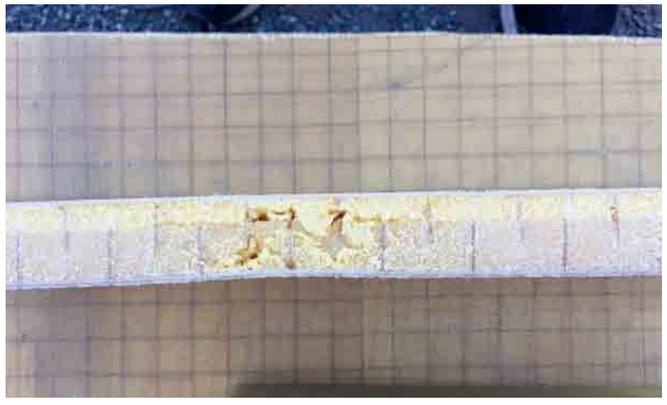
Designing power cats is a lot more of a delicate balance than most would realise: on one hand you have deck space that monohull designers can only dream of, but underneath this you have to walk the fine line between getting as much accommodation and carrying capacity into the hulls without making them so wide or full in the ends that you lose fuel efficiency and ride quality. As more of the large production boatbuilders and charter companies merge their business interests, in production power cats we are seeing a definite trend towards spacious but minimally equipped short stay accommodation and away from vessels with faster long-range cruising and offshore ability. This focus on gaining more interior space has pushed the engines further aft with the use of systems like pod drives to gain more interior room and in turn has resulted in wider hulls down aft to carry the weight. This extra width then forces the hulls to become more of the planing type, requiring more horsepower if owners want to push beyond displacement speeds. If the boat is kept in displacement mode below 10kts which is the maximum speed allowed for short distances travelled in flat sheltered waters by bareboat charter boats, it doesn't really matter nor does it matter so much when travelling short distances at planing speeds in places like Europe, as these power cats are quite efficient at higher speeds. It is however when cruising around Australia's coastline with its much larger distances between ports and safe anchorages that the type's lack of faster cruising range is exposed.

The design of the Offshore 45 walks the fine line of being efficient right through the speed range but is still able to carry enough fuel to safely make long passages by virtue of its medium waterline width 'built down' displaning hull shape where the keel forms out of the hull body for maximum buoyancy with minimum wetted surface and resistance. To compliment this ability, *Piera* then uses the combination of my CVD inside topsides and forward wingdeck features to create a progressive pick up of buoyancy in the topsides, then concentrates all of the major weights in the centre of the vessel to create a ride quality to match its log-range cruising ability. In comparing *Piera* with other power cats on the market of similar size, her mid bedrooms are more compact and boatier in feel, but having said that they are very practical with plenty of storage. Her master stateroom however is in a league of its own both in space and lifestyle as are her pilothouse, engine rooms and deck arrangement. Her equipment level is virtually the same as *Rehab*, a 58ft power cat we launched in 2014 and she is actually heavier built than *Rehab* due to the new survey requirements.

SURVEY

The owner's request that *Piera* be built to DCN (Domestic Commercial Vessel) NSCV Class 2C survey (30 miles offshore) is a very important part of the vessel's story, as it added another level of complexity to the project – understatement of the year, especially as this was the first power cat we and anyone else to our knowledge had designed and built to the full NSCV Rules using Lloyds for the composite engineering. The administration of these rules has recently been transferred to AMSA at a national level and while this didn't actually alter the written regulations, it did make a difference to the process, because the local private AMSA accredited surveyors and MSQ (Maritime Safety Qld) agents for AMSA were still working through just how the new system was going to work on the ground. With previous projects, we were able to talk to the local MSQ department if we had any questions about how to interpret the rules and in particular, how they applied to catamarans, but one-on-one contact is just not realistic anymore due to the size and scope of AMSA's DCV operations. As a result of this, the new set up required us to stick very carefully to the NSCV Rules or create solutions that were very clearly within the intent of the 'Deemed to Satisfy' allowances within the rules. The upside however for the owners with the survey being put through AMSA is that the boat can work anywhere in Australia without having to make alterations to suit individual state requirements or interpretations. There will be boatbuilders and importers plus many commercial vessel operators that will struggle with the stricter and more consistent interpretation of the NSCV Rules and regular audits by AMSA, however if it levels the playing field and makes boating safer for the paying public, then in my opinion it is a good thing.

We were lucky with the accredited surveyors we worked with on the project and all were experienced (read older like me) and highly respected, with reputations for being extremely thorough in their professions. I had worked with naval architect and stability specialist James Stephen on a number of projects over the last 20 years, worked once with Jason Locke of M2I on electrics, but had not worked before with Russell Behan of Marine Matters. All three are



TOP: Damage to hand laminated test panel with same core built Lloyds Composite Rules with same impact tests.

ABOVE: Minimal damage to infused hull test panel from impact testing even with lighter skins.

accredited with AMSA for construction and safety and Peter Cosgrove of Optimist Australia was bought in on the fire control systems. Together, their combined experience and competence was such that they were able to both inspect and review as well as giving constructive advice during the building process which was a great help.

The overall survey process began with a preliminary stability assessment to make sure that the design would pass this first critical test, which it did comfortably being a power catamaran,

The engineering process then started with Peter Schwarzel of Carbonworks being appointed as the consulting composite engineer to look at how we could optimise the boats construction while still complying with the rules and both James and I have worked with Peter successfully on many projects.

Once the preliminary work was underway and we had assessed what we needed to test and verify, Peter, James and Russell came to our workshop and witnessed the panel testing as it was important that they as much as I were confident of the results. Years ago when designing and building carbon fibre masts, another very experienced engineer had said to me that seeing how structures break is just as important as the recorded data, and he was absolutely right. For *Piera* we tested and proved the bonding system for the internal structures like the bulkheads and the module joins. We also impact tested panels made up to represent the bottom, topsides and decks and submitted panels representing the hull laminates to USQ in Toowoomba for testing, analysis and Certification. The testing at USQ was carried out on the test panels before construction began so the laminate properties could be confirmed: from this we were able to get the maximum 20% allowed reduction in laminate weights from standard under Lloyds Rules when proven by independent testing. A second set of panels were then constructed 'as built' alongside the actual hull being infused so the materials and conditions were identical – these were then tested by USQ to confirm that the boat met the 'as built' requirements. The confidence the in house testing gave to everyone involved including our employees who also watched was very important, as was having to explain every

ABOVE LEFT: Engineroom with rough water access, custom fire cladding and military spec alternator mounted on custom frame bolted to engine.

ABOVE CENTRE: S.S. watertight doors lead to aft compartment with fire-bilge pump and rudder set up with drag link.

ABOVE RIGHT: Valve in exhuast line prevents back flooding when engine shut down.

detail of what I was doing to three very experienced professionals, because this peer review made me think everything through just that much more carefully. They were all genuinely interested in what we were trying to achieve so their involvement played a considerable part in the success of the project as rather than fight the rules, which can be quite difficult to meet with multihulls, we found ways to use them to the boats overall advantage.

The down side of building a power cat to Lloyds Composite Construction Rules is that they are far more conservative than the old USL Code and the increase in weight is around 20% (even allowing for our reduction proven by testing) over the old rules and around 40% heavier in the topsides and deck structures over what some boatbuilders would use if they were not working to any construction rules. Although the Lloyds rules do not make any special allowances for infusing the laminates, the far lower resin to glass ratio obtained by infusion still saves weight and the better engineering properties of infusion were instrumental in obtaining the test results that allowed us the reduction in skin weight.

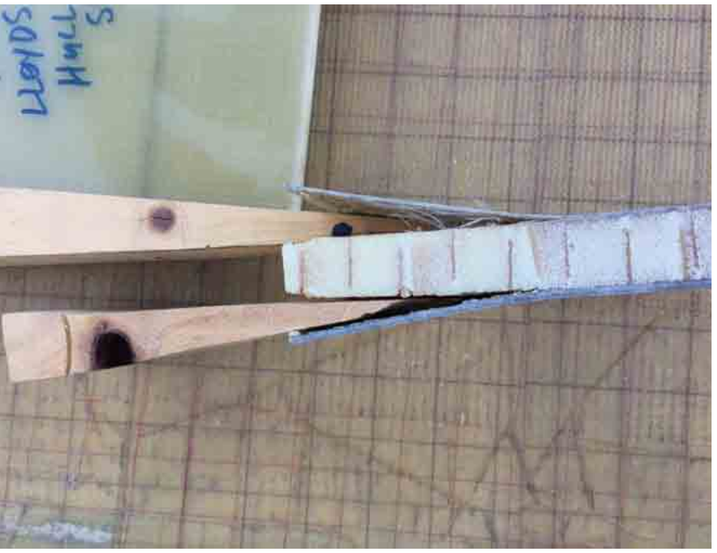
In the wingdeck area however we have learnt through experience to build to around what is required for survey on pleasure boats and on a commercial boat like *Piera*, we actually built the wingdeck stronger than the rules required.

What the testing required for survey also confirmed was the amazing impact resistance of infused vinylester laminates in combination with Corecell 'M' foam core. We have been undertaking our own impact testing for survey and non-survey boats since 1993 using a variety of resins, laminates and cores and have never seen such good results as we achieved with this combination. This can be in part attributed to the heavier skins required by Lloyds Rules, however the impact results were so much better that there can be no argument that Corecell is a very good core for impact and that infusion and in particular when you use double or triple cut cores, provides a superior core bond. I inspected most cut outs from the boats structure during construction and randomly tested the bond between core and skins and not once was I able to break the bond between the infused laminate and core.

What the owners do get when building to survey is a very solid boat that has been checked and tested at multiple levels throughout the design and construction process by accredited third parties and this was one of the reasons the owners chose this path. On the down side, it does add considerable cost and time to the construction which can be frustrating, although this is ultimately balanced by the boat's certification and therefore increased resale value.

Because a huge percentage of survey requirements are safety based, the owners have a boat with five watertight compartments in each hull and that is virtually unsinkable particularly when you combine this with the very thick foam cores used throughout the construction. They also have a boat that has a hard plumbed bilge system powered by either a 240V pump or a hand bilge pump and both can also be used as firefighting pumps. The engine rooms are painted out in a fire retardant paint and clad in fire resistant panels (a system we had to develop ourselves) well over a 60 minute burn rating, or stainless steel sheet as even aluminium does not meet the NSCV Rules on fire rating. Being a power catamaran, fire rating the enginerooms was one of the most difficult and time consuming parts to meeting the NSCV Rules. There are obviously two enginerooms and they are narrow with framing

and equipment to be worked around, along with the large aft hatch and a rough weather entrance to the enginerooms from the inside. These engine rooms are also fitted with smoke and heat detectors, have closable air intakes along with a fire suppression system and extra fire extinguishers. Each cabin also has its own smoke detector and fire extinguisher and there are two life rafts along with all the other safety equipment that leisure boats are required to carry. Whilst the fire protection and fighting systems seem over the top for a boat of this size, it is not when you rationalise that with so many watertight bulkheads and the flotation provided by the thick cores along with the twin engines and backup systems, fire is by far the greatest risk to anyone on-board.



Testing of hull cut outs have shown just how good the core bond with infusion and double cut cores is.

CONSTRUCTION

Piera was the first vessel out of the Pathfinder variable dimension hull moulds that had been further modified to increase the hull beam by 75mm and to allow construction of a range of power cats between 41and 45ft using the standard bottom mould and between 50 and 55ft in combination with the new larger hull mould.

For the construction of *Piera*, we introduced a new construction material in the form of Scott Bader's acrylic modified polyurethane glue Crestomer 1152PA. This product has been used in Europe for a few years particularly in the construction of lifeboats and so was already certified by Lloyds and other bodies, but it was new to Australia and to our knowledge had not been used in any construction under the NSCV Rules for commercial vessels. We originally planned to use Crestomer 1152PA as a replacement for fibreglass tabbing in bonding the internal structure to the hull and as our testing confirmed Scott Bader's figures and we gained confidence in its properties, we began to use it for a wide variety of other applications that even Scott Bader had not considered, including all the bonding of our DECKIT system. By eliminating virtually all the tabbing in the secondary bonding of the internal structure, not only did we save a considerable amount of labour, but we also saved weight and ended up with a cleaner interior that was easier to fit out. We also used GPET foam cores for the first time in the bulkheads, partitions and other internal structures as they are made from recycled materials, yet are still certified by Lloyds for marine construction. We did look closely at using the GPET foam for the decks and cabin as they passed the impact tests, however we decided to gradually introduce them into our construction for more impact prone structures once we had more data on their performance. We have lifted all three boats built to date out of the moulds and moved them around the shed by attaching four lifting eyes to the GPET cored bulkheads which are bonded in with Crestomer 1152PA. We also inadvertently lifted the wingdeck section of the mould which weighs two tonnes a few millimetres off the ground before it released the part without any issue and so are starting to get very confident in the materials use. *Piera* also features a new construction system for the decks and cabin called DECKIT that uses a modular moulding system to standardise the repeatable simple shapes as much as possible, then join these modules with moulded corners and radiuses so the boat has the appearance of a gelcoat finished GRP production boat, but can be easily customised to suit each owners requirements.

MECHANICALS

Piera's mechanical and electrical system are a mixture of the very conventional with a couple of layout and philosophy differences, but is still based on high quality components rather than complicated electronics.

Old school mechanically injected Yanmars combined with conventional shaft drives form the backbone of the mechanical system for strength and reliability. I am not a fan of pod drives even though they are easier and cheaper for boatbuilders to install than conventional drives and rudders. Call me old fashion, but I just consider it un-seaman like to fit a system that controls both the propulsion and steering together by electronics, given their vulnerability to a salty environment. With no individual rudders, you cannot steer the boat in a following sea unless you keep adding more power and although it is quieter to feed the exhaust out through the pod, in reverse it means the propellers are prone to serious cavitation as they try to grip in the water/air mix created by the exhaust. On top of all these concerns, I find it again fundamentally bad seamanship to run around the shallow reef strewn areas that constitute the Australian coast with unprotected forward facing propellers. I know how many times my owners have been able to bring their boats home safely with damaged props or rudders from touching a reef even with the protection of full length keels. One of my owners hit a bombie when blinded by bright sunlight 100nm off Mackay and was able to motor slowly back from the outer reefs with both rudders and propellers heavily damaged, even managing to stop and have a very successful fishing break on the way. You would have to ask yourself would a pod have survived the same damage without tearing off as they are designed to do, and with no power or steering, what would be the result be if the weather suddenly turned ugly.

As required by the NSCV Rules, *Piera* has balanced composite rudders on 2" x 2205 stainless steel stocks and an aluminium box section drag link to connect the two tillers together with drop in pins to lock the rudders amidships should the hydraulic steering fail. I have used a drag link system with a single hydraulic ram since I built the first Scimitars because I found that twin rams with a fluid link allowed the rudders to constantly move in and out of calibration, slowing the boat's performance. A drag link is more expensive to build, however once fitted it is set-and-forget for the rest of the boats life. With twin engines, survey does not require emergency steering as the widely spaced counter rotating propellers can be used to steer the boat with the rudders pinned and I know it works as we had to demonstrate its capability to the surveyors by coming into Manly boat harbour and docking with the rudders locked ahead after completing all the other mechanical tests required for survey like panic stopping from full ahead to full astern and full speed figure of eights.

Piera's fuel system is gravity fed and uses dual switchable fuel filters on each line so a filter can be changed without stopping the engine. The fuel and water tanks have locally made and extremely reliable ITIM senders and gauges with the fuel tanks also fitted with sight gauges as a backup. By opening the equalisation valve, both 1,500L fuel tanks can be filled from one side to save dragging dirty hoses over the deck or having to turn the boat around during the fuelling process.

The electrics are a little different than other boats in that they use solar and high efficiency 200amp alternators on each main engine through two Australian made Selectronic SP Pro inverters rather than a genset to run the AC system when not on shore power. The Selectronic inverter-battery chargers are high quality heavy duty units with a continuous rating of 3kw,

Tests comparing a standard Lloyds tabbed bulkhead join with a Crestomer 1152PA coved join demonstate that the coved join is over twice as strong

4.2kw for 30 minutes, 5.4kw for one minute and and a peak loading rating of 7.5kva for 30 seconds which would cover the start-up of most electric motors. They are larger and heavier than many imported inverter-chargers trading extra functions for reliability and quality components, but having dealt with plenty of owner's frustrations when their inverters did not meet the manufacturer's output claims by shutting systems down or causing component failures, I will take this trade off any day as the inverter chargers are the heart of just about every boat these days with any pretentions to be energy efficient.

The owners of *Paradigm* are using the pretty much the same system as *Piera* and have still not connected to shore power or run their back up DC gensets since the boat was launched in 2016 and *Paradigm* only has 1.2kw of solar power compared to *Piera's* 2kw. The other difference between the two boats systems is that we have switched to Lithium Iron (Li Fe Po4) batteries and whilst this has required a rethink on how the batteries capacity and outputs are measured because of the way a Li Fe Po4 battery works, this is just part of the learning curve with any new product or technology. It has been worth pursuing because the Sentry Lithium batteries are different from what has up until now been on the market for boats. They are in conventional N200 cases, don't need extra monitoring or controlling equipment and most importantly of all, they are around a third of the price of others on the market as it has been the price and custom sizes to date that have slowed the acceptance of Li Fe Po4 technology. In reality the system we have set up to run *Piera* when not on shore power is the same as any 'off the grid' domestic system and therefore given the quality of the components used, should just go about its job un-noticed. At night or if more input is required than the solar can provide when not on shore power, the alternators then take over the function of a genset, each capable of putting in 100amps of 24v power at idle and 200amps at higher rpm's. The main engines are quieter than most gensets at idle or low revs and the loads required to run the alternators have been carefully matched to the engine's horsepower at lower revs so the engines are correctly loaded.

AT NIGHT OR IF MORE INPUT IS REQUIRED THAN THE SOLAR CAN PROVIDE WHEN NOT ON SHORE POWER, THE ALTERNATORS THEN TAKE OVER THE FUNCTION OF A GENSET

The biggest difference in *Piera's* mechanical and electrical systems when compared to most other power cats and monohulls is the thought that has gone into their setup and the space allocated with both operation and maintenance in mind. There is no denying that working around the survey requirements made the layout of the systems far more difficult to stick to our plan of easy accessibility, however I believe we have still achieved it. There is full standing access to the back of the dashboard with all its electronic equipment and connections plus the DC panels from the master stateroom. The engine rooms have access from both ends and the deck hatch is large enough to lift the engines out if needed in the future. The mid bedroom cupboards have removable back walls as is the inside wall above the beds so all electrical and plumbing runs can be accessed. All electrics except the wiring to the bilge high water alarms and equipment like the hot water system and pumps are above wingdeck level and run along clear designated paths. All plumbing connections are accessible with a cold water, hot water and saltwater ring feed around the boat and *Piera* is even plumbed to hook into fresh water from shore when in port.

The exhaust system is also slightly different to previous vessels as the owners asked us to fit a 6 inch valve on the exhaust outlet so it could be shut off if steaming on one engine, was being towed or sitting on a dive site in heavy seas to prevent water entering the engine via the exhaust system. This wasn't a survey requirement as the exhaust systems outlet was high enough to satisfy the rules, however it is sensible as we have had the odd incident of water coming up in the system due to back siphoning in these conditions.

CONCLUSION

Building to the NSCV requirements under the Lloyds Composite Rules was a learning curve to say the least particularly when you add in the new materials and building techniques, however now it is done we can use this experience and data to push the composite displaning catamaran further into the wider commercial boat market with confidence.

The systems on *Piera* are comprehensive without being complicated or tricky for the sake of it, but by having a clear plan and paying attention to detail, I believe we have made them as simple to both operate and maintain with as much redundancy as possible to make the boat self-sufficient which ultimately is the aim of both the long-range cruiser and a commercial vessel. As the old saying goes "you cannot enjoy cruising our vast coast or make money if the boat is tied to the wharf". Having the boat out on the water as much as possible was both the owners and our intention and I believe the boat's design, construction and robust systems will provide this outcome.

PIERA'S EQUIPMENT

Engines	2 x 240hp Yanmar 4LHAM-STP
Gearbox	2 x Yanmar KMH 50A - 2.43:1 reduction
Stern gear	Speed Propulsions
Propellers	Veem
Steering	Capilano hydraulic
Exhaust	Foreshore Marine
Fuel filters	Marine Systems Australia
Engine controls	Morse K4 Electronic controls dual lever, dual function
Strainers	Arctic Steel
Fuel tanks	Custom GRP 2 x 1,500lt
Water tanks	2 x 330lt - Foremost Plastics
Holding tanks	2 x 110lt TMC
Pumps	Shurflo, Jabsco, Whale, Rule
Hot water system	Isotherm 75lt
Toilets	Planus
Stove	Miele induction electric cook top
	LG microwave convection oven
Dishwasher	Bosch
Anchor winch	Muir 2500 vertical rope chain with rope gypsy on top
Anchors	2 x 26kg Manson Supreme, 100m x 10mm SL chain,
Bow rollers	Maxwell S.S.
Portholes and hatches	Lewmar
Stainless fabrication	Lumark
Windows doors	Australian Marine Windows
Helm seat	2 x Bridge chairs - Reelax

ELECTRICS

Batteries	Sentry
DC panels	BEP, custom AC board
Solar panels	ARRID
Inverters	Selectronic SPMC240-M, inverter-chargers
Alternators	Echo-Tech
Electronics	Garmin supplied by Trymax
Gauges & alarms	ITIM
Refrigeration	190L Isotherm two drawer refrigerator - galley 90L Isotherm freezer - galley
Deck fridge-freezer	Ozifridge 24V eutectic chest fridge-freezer on aft deck in custom box
Washer/Dryer combo	LG 7kg
Bow thruster	Craftsman
Air-conditioning	Marine Air
Watermaker	Stella 210ltph
Dive compressor	Buer (owner supplied)