

SHIP & BOAT

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Ship & Boat visits a naval architecture practice that has made a speciality of pilot vessels to see what the future may hold.

Think of some of the more distinctive pilot boats supplied throughout the world over the last few years and there's a fair chance the name of Camarc will appear in the design credits. The naval architecture practice founded by Scotsman Alastair Cameron has carved out a useful niche in pilot vessel design. That's not to say it exclusively operates in the pilot boat market – ferries, patrol craft, crewboats and yachts are other areas where Camarc designs have figured. But think of pilot vessels that have grabbed the headlines recently, and most readers of this journal will immediately recall vessels like *Chinook* in the USA and *Humber Callisto* in the UK. Both were Camarc designs. Other significant contracts include the 10-strong *Discovery* class pilot boats, which operate from the major Dutch ports, the last one of which was delivered in 2000.

Alastair Cameron moved south to work for Watercraft, and rose to become chief designer of the company. Camarc was founded in 1986, and has always worked closely with another design and consultancy company, Amgram, which was started in 1987 by Paul Graville. Whereas there is considerable overlap between the two, Camarc tends to be the specialist in pilot and patrol vessel design, while Amgram has a wider outlook and will turn its hand towards anything maritime, taking in all types of vessel design as well as project management (which Camarc also undertakes) and consultancy.

From these modest beginnings Camarc and Amgram evolved and expanded separately, as near neighbours on the UK South Coast, until about a year ago, when the twin companies' small staff moved into a new dedicated building, a former church hall. Despite the unlikely provenance, St Julian's Hall could not possibly provide a better environment for any naval architect. Clearly visible just across the road is the entrance to Shoreham harbour, guarded by a lighthouse and with an inshore lifeboat station completing the view. We visited on a dull January day and could imagine the local pilot boat battling against the current over the harbour bar (ironically, Shoreham's pilot boat was replaced only last year by a Nelson design built by Halmatic, which must prove a touch galling to Camarc's small team of designers). But those designers need only look outwards at this classic maritime vista should they ever be in need of inspiration. It's not only the maritime views that benefit the location – it also enjoys excellent communications, with a railway running behind, and within easy reach of Gatwick airport (Shoreham too has its own small airport), and the ferryports of Newhaven and Portsmouth. Nevertheless, despite all the benefits, Alastair Cameron



Humber Callisto was built at Souter marine to a Camarc Design.

talks of a return to Scotland, establishing a design office there, and sharing his time between the two locations. Although the bulk of the UK boatbuilding business is situated on the South Coast, there are many yards in Scotland, Northern England and North Wales that could be served by a northern office.

Camarc is a truly international business, with around three-quarters of its work being undertaken for overseas clients, particularly in North America, Europe, and Singapore. Physical and virtual communications play their part, with the partners and their staff paying frequent visits to global clients, and doing considerable business by e-mail. Mr Cameron is quick to cite the benefits of e-mail, pointing out that electronic drawings can be sent to yards in, for example, North America far faster and more simply than it, comparatively recently, took to print out documents and send them by surface mail to nearby UK builders who were slow to adopt electronic methods.

Current build

Following the success of *Chinook*, the 22m 29knot aluminium self-righting pilot vessel built by Kvichak Marine for Columbia River Bar Pilots in the USA, Camarc has two other 22m North American pilot boat projects underway. They are broadly similar to *Chinook*, but without the unique self-righting capability. One is in build at Kvichak Marine Industries, Seattle, for the Sabine Pilots Association, while the other has been ordered by the Pacific Pilotage Authority of Canada, and is currently building at Point Hope Shipyard, Victoria. For projects such as these, Camarc is happy to use local consultants or naval architects to oversee the building – for example, the Canadian vessel build is being overseen by Vancouver-based naval architect Peter S Hatfield.

Camarc will prepare designs for any client, either end user or shipyard. However, the company's preferred method of working is

with known yards, and following its experience with Kvichak Marine and with Derecktor Shipyards, in New York, an arrangement has been set up for both yards to act as licensees (one for US West Coast, one for East Coast) for Camarc's 50ft, 55ft, 65ft and 72ft pilot boat designs. Camarc finds that such an arrangement gives easier access to the specialised but lucrative North American market. Although Camarc had managed to break into this market by being commissioned by Columbia River Pilots to design *Chinook* and handle the tendering process, thus establishing its good relationship with Kvichak, it is hoped that some of the success of the formal licensing agreement in areas such as fast ferries (where specialist designers like Incat Designs and Nigel Gee & Associates have benefited from such arrangements) will translate to pilot boats.

Derecktor has just completed a three-vessel series of 16m pilot boats with its latest delivery for Sandy Hook Pilots of the USA. Like most USA pilot craft, the boats were of all-aluminium construction and are capable of 25knots with a twin propeller propulsion plant.

Recent projects

Other recent pilot projects included a 19m boat for the Milford Haven Port Authority, with steel hull and aluminium alloy superstructure, built by Mustang Marine of Wales, a 16m grp launch for the Tees and Hartlepool Port Authority, built by Souter Marine, an 18m aluminium pilot boat built by Hike Metal Products of Ontario for the Atlantic Pilots, Canada, and an 11m 14knot steel pilot boat constructed by another of Camarc's long-term associates, Raidco of France. Away from pilot vessels, Camarc was involved in the design of the recent 32m David Abels-built Gosport ferry, and a steel 18m fishery patrol boat built by Raidco for service in West Africa.

Another Raidco project is currently occupying the Camarc team, a 22-boat class of 20m grp police vessels (see News, this issue). Camarc has also been involved with the RNLI's new 13.6m FCB-2 lifeboat, a fast all-weather self-righting boat capable of launch and recovery from a beach. This programme is currently ongoing with model tests being carried out and a boat, not to the final design, currently with lifeboat crews undergoing evaluation of the proposed waterjet propulsion system.

There are other projects in the pipeline, including possible follow-on orders from the UK, and when we visited another interesting project was drawing to a conclusion.

This last project was for a crewboat to be built in Singapore. The contract was only placed in August 2001 and even Camarc, with all its design experience, felt it was a tall order for the design to be finalised and the boat built by early 2002, but the company was willing to give the project its best shot. Indeed, in late January the boat was at sea, and although there were some minor details to be sorted out, it was performing to specification with a 25knot loaded speed despite having come out of the yard a little overweight.

Looking to pilot boat market developments, Camarc works on the philosophy that there can be no standard pilot boat design. Every port and every pilotage authority has different requirements and different priorities. Camarc likes to listen to its clients' needs, their experiences, their priorities, and problems faced at present and in the past in order to come up with the optimum solution. The way that design contracts are placed is one key factor. In the USA, for example, the pilotage authorities tend to be owned and operated by the pilots themselves, whereas in Canada and Europe it is usually the port authorities that handle pilotage. On the face of it, the USA system might appear better – the pilots being more likely to know their requirements than another body, which could well be controlled by accountants. Things are never that straightforward, though. It can often prove difficult for pilots to agree among themselves on which are the most important requirements, while a cost-driven contract can still produce excellent boats, particularly when through-life costs are taken into account rather than just capital expenditure.

Fendering – key development area

Perhaps the single most important aspect of pilot boat design is repairability and maintenance, with repairs to hull damage usually proving to be the major cost in the boat's life cycle. As a result, fendering is probably the key area of development in boat design. The Popsafe system as used on *Chinook*, with similar arrangements on recent deliveries for the Humber and Tees pilots has many advantages, being able to spread impact loads over a much larger area than with conventional fenders. However, abrasion resistance is perhaps even more important where a small boat constantly rubs against the



The Columbia River Bar pilot vessel *Chinook*, built in aluminium by Kvichak Marine, with a unique self-righting capability.

sides of large vessels in heavy seas. A large foam section covered with polyethylene tube is very effective in spreading the load and resisting abrasion. Mr Cameron believes that new and even more effective fendering methods are likely to be the most significant advance in the short to medium term.

As far as the basic boat design is concerned, Mr Cameron sees no reason why the standard monohull pilot launch should fall out of favour. Developments such as Swath hull forms, and even use of helicopters rather than boats for pilot transfer, have their own advantages and may well prove better in certain instances or during certain conditions. But cost considerations will, he feels, keep the conventional pilot launch to the fore, particularly with proven hull forms such as Camarc's own double chine design (see panel) which is employed on virtually all of its pilot and patrol craft.

The size of the boat is another area where different clients have different priorities. There is a distinct trend towards larger boats, particularly in North America, where 22m seems to be almost an average size for a pilot boat, and size does not necessarily preclude high speed – the recent current large boat projects in North America are all capable of a 25knots-28knots continuous speed, with a maximum of up to 30knots. Indeed, there seems little need for more than 30knots. The current vessels offer a fast response and perform well in most conditions. Higher speed means either bigger, more complex, propulsion systems, or lighter vessels, both of which have a great influence on both costs and reliability.

Waterjets vs propellers

As far as propulsion systems are concerned, there is a choice between propellers and



The Camarc-designed 19m 20knot steel pilot boat delivered to Milford Haven at the end of 2000.

waterjets. Camarc offers designs with both systems, and there is no clear preference either among users or designers. Faster vessels tend to go for waterjet propulsion, as propellers are generally more efficient below 25knots. For most pilot vessels, however, normal operating speed is in the 22knots-28knots range, which can point towards either jets or propellers, and Camarc believes in evaluating the different options according to customer needs. Neither is 'best' – what has to be done is to compare a good propeller design with a good waterjet installation. Hull design is an important factor; many hull forms show resistance profile with a definite 'hump' around 14knots-16knots, which means propellers are likely to be more suitable. Camarc's double chine hull is designed to eliminate such a hump, making it equally applicable to propellers or jets.

One fundamental difference is that waterjets will absorb engine power independently of boat speed, whereas propellers will rapidly overload (or reduce engine rev/min) if power is applied while boat speed is restrained, something which rarely occurs with pilot boats. Another difference is that boat manoeuvring characteristics are very different, and proper crew training is vital. However, having undergone such training, most crew find that waterjets allow manoeuvres that would be difficult or impossible with propellers. During manoeuvres, it is the jet that absorbs the thrust rather than the gearboxes, with jet controls used for close quarter steering and ahead/astern direction. This results in less stress in the engine and gearbox, though it does mean that the waterjets themselves can be stressed in pilot boat use. Most waterjets seem able to cope well with these stresses, and although no one make has any real advantage, Camarc finds that Hamilton jets are very popular and have proved very



The new 22m Camarc-designed boat for Pacific Pilotage Authority, Vancouver.

reliable in pilot and patrol applications. Camarc also recommends fitting a waterjet one size larger than that which might prove 'just adequate' in order to improve durability. This undoubtedly has an impact on initial cost – particularly as waterjets are expensive to start with – but will pay off in the longer term, not only through less wear and tear, but fewer effects of weight growth and fouling on boat performance.

Camarc cites the advantages and disadvantages of the two systems as being:

Waterjets: Pros; manoeuvrability, safety, protection, less stress on machinery.

Waterjets: Cons; cost, lower low-speed efficiency.

Propellers: Pros; cost, high low speed efficiency, less complex on-board systems.

Propellers: Cons; vulnerable to external damage, less safe in casualty situations, less kind to transmission and engine.

The company says that advice on the best for individual applications can only be given by weighing the various factors, and that

advice comes automatically as part of its design package.

Variety of construction

Construction material is another area where there is no clear 'best' or 'worst'. The choice is governed primarily by available resources for building, repair and maintenance, with repair being the most important, but also by weight and speed considerations. Aluminium and grp prove most popular for faster craft, but fast pilot boats have been built successfully from steel.

One area which is growing in importance is comfort. This is driven not just by the demands of pilots and crews, but by health and safety legislation. With larger vessels offering live-aboard facilities, it is particularly important to provide a good working and living environment. Whereas ten years ago machinery might have been solidly mounted, now not only is it common for engines to have flexible mounts but wheelhouses too can be fully floating to reduce noise and vibration. Similarly, basic heating systems were the norm a few years ago, now full air conditioning is commonly provided.

Other areas where different clients have different requirements include rescue equipment – either over the side or transom-mounted, or a combination of both. The transom platform on *Chinook*, despite some complex cantilevering arrangements to clear the large waterjets, has proved a particularly elegant solution.

No standard design

Mr Cameron stresses that in his experience a standard pilot boat design is something that just cannot exist. Successful designs can be reproduced and adapted – as has happened with the 22m USA craft – but each user has different needs and different priorities which must be accommodated at the design stage. Despite what is happening in some areas – the discussions on pilotage in the Humber area is particularly interesting – the traditional monohull pilot boat, in whatever length and whatever material, is here to stay.



The new 22m Sabine Pilots boat, a near sister to *Chinook*, and in build at the same yard, Kvichak Marine of Seattle.

Camarc's double chine hull form

In establishing its basic pilot boat hull form, Camarc considered the requirements to be seaworthy and safe throughout the operating speed range, to offer sufficient volume to contain the required accommodation and machinery and the ability to carry the payload, and to offer good hydrodynamic resistance characteristics. The classic round bilge semi-displacement pilot boat hull has worked well at low to medium speeds, but at higher speeds powering requirements increase and it becomes less dynamically stable than is desirable. Although a shallow deadrise chine hullform will perform well at speed and offers good interior space, a deadrise of less than 10deg will be unsuitable for use in any but the calmest of operating conditions. The deep forefoot usually applied to such hulls to reduce slamming does not perform well in a following sea, and can cause the boat to 'trip' and bank outboard, which would be most undesirable during pilot transfer.

With fuel costs, which are directly related to hull resistance, forming a significant part of operational economics, the hull needs to be easily driven while retaining stability and volume – narrow beam, low deadrise and light weight will all keep speed up and fuel costs down, but such a hull is not likely to offer volume or stability. As pilot boats have to operate at low speeds as well as high speeds, and in particular to remain stable at low speed or at rest, a hull form is needed which provides a combination of stability, volume, low resistance and – above all – seaworthiness. The latter is defined by Camarc as a combination of dynamic stability, motion, dryness, acceleration, and, above all, confidence which allows the crew to trust the vessel and concentrate on the required task.

Camarc's solution is the double chine hull, which combines elements of the semi-displacement hull's seakeeping with the speed and stability of the hard-chine hull. Described as evolutionary rather than revolutionary, it offers several important features.

- It exhibits increased large angle stability levers (GZ arms) for a given waterplane area, due to the increased hull volume offered by the upper chine.
- Increased deadrise for the forward sections compared to a single-chine hull, reducing accelerations in head or quartering seas.
- Twin chines forward help deflect spray and result in drier running in heavier seas.
- A smooth curving forefoot and increased hull volume due to the twin chines offers good directional stability in following seas.
- The after body is close in form to a conventional chine hull, resulting in less roll than a round-bilge hull.
- The double chine hull offers good, consistent resistance characteristics, particularly in the medium speed 'hump' stage.

The basic hull form can be varied according to requirements. Typically, deadrise is 18deg at the transom, 25deg amidships and 35deg at the bow, with smaller faster craft having increased transom deadrise. For larger fast craft it becomes a high priority to minimise vertical acceleration, particularly in the zone aft of amidships which is traditionally the most comfortable area in high speed vessels. To maintain comfort, it is important to run at the correct trim angles, as a too-low (less than 2.5deg) angle can perform badly in following seas and suffer dynamic stability problems, whereas at over 3.5deg head sea performance diminishes. Camarc's experience shows that its double chine hull form proves effective in maintaining correct trim angles without the use of controllable trim tabs.