

ADVANCED SEAFRAMES FOR LITTORAL SECURITY



AUSTAL





USS Independence is the first of a new generation of aluminium trimaran Littoral Combat Ship

THINKING WITHOUT BARRIERS

Austal is re-writing the rule book in the design and construction of vessels for military and security applications

Navies have often been regarded as among the most conservative of customers, inherently wary of radical innovation in naval architecture and ship design. This stereotype is not without foundation or reason: first, the marine environment is harsh and unforgiving, and every major warship represents a significant capital investment designed to have a service lifetime spanning between two and three decades; second, navies have by and large pursued an incremental approach so as not to inadvertently cast away the hard-won lessons of operational experience accrued through both peacetime and conflict.

Yet paradoxically, this slow and evolutionary natural order of warship development has been punctuated at key junctures by the bold adoption of innovative ship design, marine engineering and/or system architecture approaches that depart radically from conventional wisdom. These paradigm shifts generally occur when technological breakthroughs and operational imperatives coalesce to create the conditions for fresh thinking, novel concepts and new enterprise solutions.

So it is perhaps no coincidence that the emergence of Australia-based aluminium shipbuilder Austal as a growing force in the defence market has come at a time when many navies are radically reappraising the capabilities and characteristics required of their future fleets. No where is that more apparent than in the United States, where the huge potential of advanced aluminium seaframes is being very firmly grasped for both littoral warfighting and intra-theatre logistics missions.

From humble origins in 1988, Austal has set out to differentiate itself from 'industrial-age' shipbuilders, and in doing so sought to challenge the conventions and break the moulds so long associated with traditional practice. This is evidenced by its advocacy of marine aluminium alloy as a material of choice; a willingness to embrace the hydrodynamic, powering and layout benefits afforded by advanced high-speed multi-hull forms; an assembly-line production philosophy that owes more to modern aerostructures manufacture than its does to

classic shipbuilding practice; and a customer-focused delivery culture that endures well beyond vessel acceptance.

It was these tenets that initially brought the company success in the commercial arena. As John Rothwell, Austal's founder and chairman, reflects: "Our original vision was to build medium-size fast catamaran passenger ferries, with a firm focus on the Asian market. We honed our skills in this sector, putting particular emphasis on production facilities and manufacture efficiencies to enable us to offer tailored designs at affordable prices."

These same principles were later translated to meet the needs of customers in the defence and security sector. "The company saw a need in the late 1990s to diversify the product portfolio as the ferry market softened," says Rothwell, "We identified opportunities in the defence and paramilitary sector, and in 1998 achieved a first success with an order for eight patrol boats for the Australian Customs Service."

Fast forward to the present day. From its small beginnings, Austal has progressively grown through a combination of selected acquisitions, advanced design development, leverage from the commercial sector, far-sighted investment in new plant, process and information technology, and a strategy of product and market diversification.

As a result, the company's production resource now encompasses three facilities located close to its headquarters in Henderson, Western Australia, a vessel production/refit yard in Tasmania specialising in vessels up to 60 metres, and Austal USA's new state-of-the-art ship construction and assembly operation in Mobile, Alabama. Equally important, it

has built up a strong multi-disciplinary team of almost 200 naval architects, engineers and designers in-house, giving the company a complete capability for the design of advanced aluminium vessels while at the same time ensuring hands-on construction oversight, and reduced design and construction integration risk.

The past 14 years have seen the company continue to build on its early successes. On the commercial side, it has become a market leader

in the design and construction of a new genre of fast multi-hull ROPAX ferries that have revolutionised the economics of point-to-point sea freighting. This has included the pioneering 127 m vehicle/passenger ferry *Benchijigua Express*, the largest trimaran vessel in commercial service anywhere in the world.

In parallel, Austal has carved a niche in the defence sector. As well as establishing itself as a leading supplier of flexible but affordable fast patrol craft to the Royal Australian Navy and other local and international government agencies, it has more recently achieved notable success in applying its innovative aluminium multi-hull design and construction expertise to meet the needs of the US military.

According to Rothwell, it was around the turn of the century that the US armed services first began to appreciate the potential of commercial high speed vessel technology for military purpose. "There was an awakening of interest in how fast ships could serve as intra-theatre sealift assets, and shortly afterwards, the US Marine Corps chartered the 101 m *WestPac Express*, at that stage the largest of Austal's Auto Express series of vehicle-passenger ferries, to serve as a high



The Royal Australian Navy operates 14 Austal-built Armidale class patrol craft



speed theatre logistics vessel supporting the Third Marine Expeditionary Force in Okinawa.”

Encouraged by this burgeoning interest in theatre sealift, later to become a joint service Program of Record, Austal took a strategic decision to establish a manufacturing footprint in the United States. This was achieved through a joint venture, established in 1999, which saw a brand new facility built on Pinto Island, Mobile, initially to build commercial craft. Austal USA went on to take full ownership in 2006.

While the US services began to develop a requirement for a new class of Joint High Speed Vessel (JHSV), another US opportunity presented itself in the shape of the Littoral Combat Ship (LCS) programme. “We were able to bring the US Navy across to visit *Benchijigua Express* and convince them of the advantages offered by a trimaran,” says Rothwell. “Our design was subsequently downselected as one of two LCS seaframes to go into build.”

Further success followed in 2008 when Austal USA, by now fully accredited as a secure site, was selected to deliver the JHSV programme to meet the combined needs of the US Army and US Navy. An initial requirement exists to build 10 vessels using a commercially-derived catamaran design, but as Rothwell points out, the final number “could be more than double this figure.”

So what are the factors that have shaped this success? For one thing, Austal has honed a design resource unrivalled in its understanding of high performance aluminium ships, offering a wealth of expertise and a proven ability to engineer customised solutions to meet specific user requirements. In parallel, it has maintained a vibrant research and development programme that has matured innovation in hydrodynamics, structures, power and propulsion and ride control.

Next, it has succeeded in migrating commercial off-the-shelf (COTS) design solutions into the military environment by methodically engineering proven aluminium fast ship technologies into high performance designs – without compromise to operability, safety or survivability. This is borne out by a track record of 69 vessels delivered, in build or on order, to

12 armed forces and law enforcement agencies worldwide.

The company has also invested in the in-house development of key system technologies interwoven into its advanced high speed multi-hull designs. For example, Austal’s MarineLink ship monitoring and control network allows for comprehensive real-time monitoring and management of machinery and systems ship-wide from the bridge. In addition, MarineLink produces trend information to support vessel operation and platform diagnostics.

Similarly, Austal has continued to cultivate its own expertise in ride control systems. This capability includes sophisticated computer-based modeling tools to predict and evaluate sea-keeping performance, and the development, manufacture and integration of software-controlled motion control systems to reduce ship motions at speed and in higher sea states.

Production efficiency is another major contributor to Austal’s performance and competitiveness. The company’s manufacturing facilities have been optimized to streamline workflow and maximise productivity, with a particular focus on large scale modular pre-outfit.

Offloading from *WestPac Express*



Intrinsic to this continuing drive for efficiency is the Advanced Ship Building (ASB) programme, a continuous improvement and change management initiative woven into the fabric of Austal's business. ASB is all about improving efficiency and increasing output quality, achieved through the adoption of new operating processes and manufacturing techniques, integrated project planning, coordinated logistics, greater accuracy in piece part manufacture, and rigorous configuration control.

Further benefits are anticipated from the roll-out of a waste elimination programme based on 'lean' manufacturing principles. This is already delivering significant gains in productivity alongside improvements in quality and shopfloor safety.

The other special ingredient, Rothwell believes, is a culture and mindset that challenges conformity and puts the customer first. "There is very much a 'can do' approach," he says, adding "Our business has been all about giving clients, whether commercial or military, solutions that were simply unattainable using traditional approaches. We've done that through innovative engineering and world-class manufacturing.

"Austal is leading in an industry where no one else has been, so we can't copy. We're thinking without barriers."

Looking to the future, the corporate business plan anticipates a continued intake of both commercial and defence work, with the latter expected to account for slightly more than half of group turnover in the longer term. Austal USA will focus its operations on the military market, with high hopes that LCS and JHSV production will be buoyed by international orders through US government Foreign Military Sales.

Outside of the United States, Austal is examining options to establish a specialist military production facility operating separate to its existing commercial build facilities. This would harness the production efficiencies of the company's alu-

minium shipbuilding operation, while at the same time providing a secure site environment aligned to the more complex integration, certification and security requirements of naval customers.

What's more, alongside its established range of patrol and auxiliary boat designs, Austal is introducing a new Multi-Role Vessel concept that combines the efficiencies and layout advantages of the trimaran hullform with a system of modular mission payloads. The result is an agile yet affordable littoral combatant geared to the needs of the 21st century navy.

Another line of development is through-life service support. Austal has taken responsibility as the ship manager for WestPac Express, including planned maintenance management, and is also providing support to the Royal Australian Navy's Armidale class from an operation in Darwin operation. And its five-year support package for new patrol boats built for Trinidad and Tobago is likely to be a portend for things to come.

There is also an acknowledgement that Austal should adapt to a global marketplace where customers increasingly aspire to in-country manufacture. Rothwell points out that the company "is open to exploring options for technology transfer, whether through the direct licensing of designs or the creation of joint ventures".

Austal remains a young company, celebrating the 21st anniversary of its formation in 2009, yet its track record of success, first in the commercial market and now repeated in the defence sector, suggests it has more than come of age. In a short time, it has effectively torn up the conventions of military shipbuilding by applying commercial business processes and COTS technology solutions carefully tailored to meet the capability requirements of defence customers. Above all, Austal has shown that things *can* be done differently.

Extensive in-service experience with aluminium hulls, together with a continuing programme of research, development and technology demonstration, has given Austal the confidence to argue a persuasive case for using aluminium material in naval hull structures. Indeed, as misconceptions and prejudices are overcome, an increasing number of navies have recognised the benefits of reduced structural weight, better fuel economy and enhanced corrosion resistance that aluminium confers.

Aluminium is approximately one third the weight of steel, offering a far lower lightship displacement and therefore increasing speed and fuel efficiency without sacrificing structural strength. It is also an extremely robust material for marine operation; in the case of a high shock loading, the high ductility of aluminium ensures that significant panel deformation can be tolerated before structural failure.

The corrosion resistance of marine grade aluminium alloys ensures that protective coatings are not required on all hull surfaces. A protective aluminium oxide layer that forms

on the material surface ensures that bilges, tanks, voids and other internal spaces do not require the level of maintenance, and coating that steel hulls do

Aluminium and steel are alike in that both materials are non-combustible and do not burn. The key behavioural difference is that aluminium alloys lose strength at a lower temperature than steel (degradation starting at temperatures between 150 and 180 degrees C).

Austal recognises that aluminium's increased susceptibility to fire damage demands increased structural fire protection in those areas of fire risk, this being delivered through a ceramic fibre wool material and the installation of active fire suppression systems. However, the substantial difference in structural weight more than offsets the weight of additional fire protection measures.

The company also points out that aluminium conducts heat more effectively than mild steel. This thermal conductivity assists in the dissipation of heat during a fire and allows rapid boundary cooling of exposed structures.



Austal's highly skilled workforce delivers outstanding efficiency and quality

Matching finite budgets to an ever-widening range of maritime security and warfare enabling tasks is a problem that continues to challenge navies worldwide. Many forces are discovering that the one-to-one replacement of existing minor war vessel types – patrol vessels, mine countermeasures craft and survey ships – is both unaffordable (in terms of acquisition cost) and undesirable (given the training, logistics, organisation and manning overheads that aggregate through-life from a series of unique, niche and largely bespoke platforms).

As a consequence, there is significant evidence of a shift in thinking towards the concept of a modular and reconfigurable minor warship design that confers an ability to be reconfigured to satisfy a range of different roles according to the specific mission payload embarked. Reconfigurability is increasingly attractive to navies that want to be able to adjust the balance of roles and missions performed by individual units warships in a flotilla as tasking priorities evolve over time. This offers improved role (versus hull number) flexibility through life.

This trend is reflected by a number of emergent platform/capability requirements. For example, Australia's Project SEA 1180, as a core component of the Royal Australian Navy's Force 2030 vision, plans to replace legacy patrol boat, mine countermeasures (MCM), hydrographic and oceanographic forces with a single modular multirole class of Offshore Combatant Vessels.

In articulating this approach, the Defence Capability Plan 2009 describes the rationalisation of the small ship fleet as "an opportunity to leverage the advantages of platform and systems commonality as far as it can be implemented to fulfil a range of maritime missions". It adds that its planned approach "is intended to exploit the advantages of using either the same vessel or a family of vessels to conduct offshore security, mine countermeasure and hydrographic roles," noting that, where possible, "this vessel or family of vessels will employ modular concepts that enable each to be employed in multiple roles to meet the needs of particular operations or strategic circumstances".

Austal has already started thinking along similar lines. Drawing on its in-house design expertise, together with feedback garnered from the RAN and a host of other international navies, it has produced an innovative Multi Role Vessel (MRV) design that succeeds in melding the powering, seakeeping and layout advantages endowed by an aluminum trimaran seaframe with the adaptability afforded by a modular payload system. The result is a supremely agile and cost effective open architecture platform that transcends traditional ship typologies to deliver superior operational flexibility.

Having already brought large high-speed trimaran technology into the military marketplace in the shape of the LCS, Austal has continued to evolve and finesse the basic design in order to further optimise performance, ride control, fuel

VERSATILITY WITHOUT COMPROMISE

Austal's Multi Role Vessel offers a new and innovative approach to meeting a raft of maritime security needs

efficiency and payload. These improvements are embodied in the next-generation AutoExpress 102 vehicle/passenger ferry, construction of which completes at the company's Henderson yard in early 2010.

The MRV has been designed to capitalise on this pedigree, providing users with a versatile yet cost effective littoral seaframe that exploits the inherent advantages of the trimaran hullform to offer significant advantages over a similar-size monohull. These include improved hydrodynamic performance and greater propulsion efficiency, increased internal volume for a flexible mission/logistics deck, and a large and optimally sited flight deck and hangar for helicopter and/or unmanned air vehicle operations and support. Austal's concept combines these features with a core combat system -- scaled for situational awareness and self-defence -- and a ship service infrastructure that supports interfaces to a wide range of mission payloads suited to specific naval, maritime security, theatre logistics, law enforcement, and humanitarian roles.

The result is an 80 m platform that seeks to redefine the term 'multi-mission' by offering the prospect of true 'plug and play' operation. This in turn offers end users a highly adaptable asset that can be rapidly reconfigured to deliver capability across the full spectrum of operations.

A stand-out feature of the design is the mission bay area that provides a large storage and/or working area. Payloads can be moved internally by means of a gantry crane, or moved out to a V-notch in the transom for launch.

Vehicular access is via an aft stern ramp, while an aft crane allows for cargo handling and the launch and recovery of small craft and unmanned surface vehicles. Austal is continuing to investigate novel motion-compensated capture mechanisms that enable recovery operations to be safely



Aft view of the MRV

The MRV has been specifically designed to offer maximum versatility in service



and efficiently performed in higher sea states.

The hangar and flight deck are sized for an MRH-90 type helicopter. The inherent stability of the trimaran form, together with the positioning of the flight deck nearer to the center of pitch, significantly reduces motions so as to expand helicopter operating limits in rough weather.

Austal believes the MRV offers an ideal platform from which to perform EEZ surveillance and maritime security operations, championing both the efficiency and seakindliness of the MRV seaframe. While the design is capable of sprint speeds approaching 30 kt, most operations are likely to be undertaken at an economical cruise speed between 12 kt and 15 kt, a powering regime where the hydrodynamic efficiencies of the trimaran form yield significant savings in fuel consumption compared to a similar monohull. Furthermore,

While Austal does not carry the significant overheads associated with the maintenance of an in-house combat system engineering group, it has steadily built up a proficiency in the integration of affordable sensor and weapon suites matched to constabulary and self-defence requirements. At the same time, the company is increasingly working with third party combat system suppliers to integrate their combat management, sensor and weapon systems within its aluminium seaframes.

The MRV provides an ideal example. Austal has defined a core combat suite that delivers a level of situational awareness and tactical control commensurate with the maritime security and littoral surveillance missions that the vessel

is ideally suited to. This would typically include a compact open architecture combat management system, a tactical air/surface surveillance radar, a radar/electro-optical weapon control infrared surveillance system, electronic support measures and communications intercept/direction finding.

Effectors would also be tailored for the littoral security mission. A baseline fit could include a 57 mm dual-purpose medium-calibre gun and a number of small-calibre weapons for policing operations and close-in protection. Navies looking for a more substantial armament could additionally fit a lightweight surface-to-surface guided weapons and/or a very short range air defence system, together with soft-kill chaff/infrared decoy launchers.

the low motion characteristics of the platform are ideal for an asset that may be required to loiter on station for extended periods.

Of course, the benefits of improved seakeeping and seakindliness are not just confined to crew comfort. Ship evolutions involving a ship/sea and/or ship/air interface require low motions to endow acceptable safety and operating limits, while the MRV's multi-hull form naturally provides a sheltered area for the launch and recovery of boats or unmanned vehicles. These self same attributes lend themselves to the operation of a next generation of offboard MCM and hydrographic survey systems, embarked in the form of containerised and portable modules, that will rely on the deployment of long-range autonomous vehicles from 'stand off' distances.

As for sealift and intra-theatre logistics, the MRV offers seating area to accommodate an embarked military force equivalent to an entire battalion, with space in the mission deck for vehicles, cargo and containers. The craft's shallow draft characteristics (less than 3 m) and excellent close quarters manoeuvrability enable it to access austere and confined port arrangements.

This intrinsic payload flexibility and ability to operate in waters close inshore further lends itself to humanitarian relief missions. In this case the mission deck could accommodate containerised medical facilities, relief supplies, mobile workshops and engineering vehicles.

While the MRV will be built to commercial classification society standards, measures will be implemented to provide some degree of 'hardening' for mission systems. These include shock-tolerant cabinets for electronics hardware, and the selective application of lightweight armour around critical operational spaces.

Combining innovative design with proven, state of the practice technology, Austal's MRV concept offers navies and coast guard's a new route by which to deliver a wide variety of maritime security and enabling roles from a single platform.

SECURITY IN THE LITTORALS

**Customers worldwide are turning
to Austal for the supply of high
performance patrol craft**

Nation states today find themselves faced with increased responsibilities to monitor and police the activities within inshore zones, along their coastlines and beyond into the EEZ so as to protect maritime borders, safeguard offshore installations, resources and ecologies, deter criminal elements and counter threats to national security. This requires a flexible, responsive and cost-effective seaborne patrol capability to ensure the integrity of territorial waters, and deter or apprehend those undertaking activities outside the law, ranging from illegal fishing, environmental transgressions and narcotics smuggling to human trafficking, piracy and maritime terrorism.

At the same time, there is a continued requirement for robust, adaptable and sea-kindly vessels able to demonstrate sustained presence, and contribute to the maintenance of good order at sea, maritime safety, and search and rescue.

Responding to these varied operational demands, Austal has over the last decade evolved a line of high performance aluminium patrol boat and auxiliary vessel designs that can be individually scaled and tailored to meet the specific needs of the end user, be it a navy, defence force, coast guard or other paramilitary agency. Characterised by attributes of speed, manoeuvrability, shallow draft, low-manning and reduced maintenance, they enjoy the benefits of proven V-hull aluminium platforms that combine economical performance with superior seakeeping. Furthermore, the inherent flexibility of each design allows customers a wide choice in the selection of equipment and vendors to suit specific operational and/or local supply chain and support requirements.

Austal's first success in this market came in 1998 when it was awarded a contract to build eight 38 m 'Bay' class patrol boats for the Australian Customs and Border Protection Service. Since then it has gone on to secure orders from eight military/law enforcement customers for 55 patrol vessels varying between 16 m and 56 m in length. The pedigree of this 'back catalogue' includes 10 patrol vessels for the government of Yemen and the Royal Australian Navy's 14 Armidale class patrol boats, the latter procured to meet the requirements of Project SEA 1444.

What marked out the acquisition strategy for Project SEA 1444 was the Department of Defence's adoption of a performance-based requirement. Rather than specify the detailed characteristics, performance and number of vessels, Defence instead sought to define a patrol boat capability based on operational availability, and let industry decide on the number of platforms and associated support strategy

required to most cost effectively deliver this output.

The Armidale build programme, contracted in December 2003 as part of a 15-year package that also incorporates through-life maintenance and support, represented a breakthrough for Austal given the pace of delivery, the range and seakeeping performance demanded of the vessel, and the requirement to integrate a compact but highly capable weapon, sensor and communication suite. Today operating from bases in Cairns, Darwin and Dampier, the Armidale class vessels are making a significant contribution to patrolling Australia's vast EEZ.

As well as earning praise from the RAN for its reliability, habitability and seakindliness, the Armidale design also serves as a reference point for the advantages of aluminium construction. Its use has resulted in an annual fuel saving of more than 20% compared to a similar steel design, equating to a saving of around 2.1 million litres of fuel per year for the 14-strong fleet. This, coupled with reduced maintenance overheads, is generating significant life cycle cost savings.

More recent patrol craft orders have reaffirmed Austal's ability to utilise its high productivity design and manufacturing capability to deliver customised products against the tightest programme schedules. In April 2008, following a competitive tender process, the Republic of Trinidad and Tobago awarded the company a contract to construct six 30 m APB 30 fast patrol boats for service with the Trinidad and Tobago Coast Guard (TTCG), an order which marked the first defence sale for Austal in the Caribbean region.

According to Commodore Garnet Best, Director of Trinidad's Defence Transformation and Integration Secretariat, the technical and commercial proposal put forward by Austal won out because it "offered the best overall package, which covered the provision of the vessels, training and maintenance".

These new craft, all delivered by the end of 2009, will support the TTCG in providing sustained surveillance in the country's internal waters, the archipelagic territorial sea and its exclusive economic zone. It is intended that the vessels will play a major role in ensuring the safety of shipping, as well as the preservation of the marine environment. They will also target the illegal trafficking of drugs, contribute to safety at sea, and perform search and rescue duties.

"Our first impressions of the vessel were excellent," says

**Six APB30 vessels
have been delivered to
Trinidad and Tobago**



Commodore Best, "with the boat maneuvering well and the speed was right up over 40 knots. We are confident that the speed of the vessels will contribute to their effectiveness in the interdiction of illegal drugs."

Classed to DNV standards, the APB 30 typifies the new genre of fast patrol vessel for which Austal expects a steady demand in the years ahead. Powered by twin MTU 16V 2000 M92 series diesel engines driving Rolls-Royce Kamewa size 56 waterjets, it can achieve a maximum speed of 40 knots and a maximum range of more than 1,000 nautical miles. Operating with a crew of 12, each craft is being equipped in service with a 20 mm cannon and three General Purpose Machine Guns.

As part of its full service commitment, the company delivered a comprehensive customer training programme at its dedicated training facilities in Western Australia ahead of vessel delivery. The package comprised two parallel streams: a familiarisation training programme for TTCG deck officers and ratings; and a maintenance training programme for engineer officers and ratings. Further training to TTCG personnel will follow in Trinidad and Tobago from early 2010.

It should be pointed out that Austal's responsibilities to the TTCG did not end with vessel handover. Under a separate but associated contract, the company is providing a five-year comprehensive maintenance and support service incorporating scheduled planned and preventative maintenance support, unscheduled maintenance, management and performance of annual surveys and maintenance periods as well as shore-based engineering support.

Austal's high quality and price competitiveness have also continued to find favour with law enforcement agencies, with the Queensland Police Service recently taking delivery of three 22 m catamaran vessels designed for extended patrols

With many customers now placing an increased emphasis on asset availability and more cost-effective capability management through-life, Austal is growing its capability to deliver comprehensive full-service logistic support packages across its range of defence and security platforms.

Drawing on the extensive experience of its global service network, the company is now able to offer tailored through-life support packages to ensure optimised vessel supportability and reduced lifecycle costs. These services include maintenance planning, logistic support, operator and



Four IPCs have been built for Malta

in remote tropical areas. Built by the company's Tasmanian shipyard, which specializes in small to medium size vessel construction, their clever but compact design include the ability to drive on/drive off a rigid inflatable boat on an aft ramp.

In February 2009 the Armed Forces of Malta (AFM) reaffirmed Austal's competitiveness in the patrol craft market by placing an order for four 21.2 m inshore patrol craft. This is a milestone contract in that it hails a first breakthrough for the company in the European defence market. It also highlights Austal's ability to meet exacting customer demands in exceptionally short timescales, with just nine months between contract signature and delivery.

The AFM, which has responsibility for security in Malta's territorial waters, will employ the four vessels for surveillance and border protection missions around the island state's coastline. Each vessel will be equipped with a 12.7mm heavy machine gun forward and two 7.62mm light machine guns on the aft flybridge deck.

Operated by a crew of eight, the craft will offer much improved crew comfort and safety. Twin MAN D2842 LE410 diesels, diving fixed pitch propellers via ZF gearboxes, deliver a maximum speed of over 26 knots.

Adding to the design's versatility is a bilge manifold located above the main aft deck, which can perform salvage pumping of another vessel if needed. A stern launching ramp allows the safe deployment and retrieval of a rigid inflatable boat and dive operations are also supported via low-to-the-water platforms located aft. The vessels also boast fire fighting capability via a fire monitor on the aft flybridge deck.

Sea trials of the first two Maltese inshore patrol craft began in early October 2009. Delivery of all four vessels has been completed on schedule.

maintainer training, unprogrammed maintenance and repairs, technical consultancy, safety management, post-design services, and assistance with dry docking and surveys.

Austal's service is inherently flexible so that support packages can be customised to suit the unique needs of individual operators, ensuring they are provided with support that is effective, efficient, and coherent with capability, availability and affordability requirements. This includes the provision of innovative and locally sustainable solutions that make best use of in-country infrastructure and supply networks.



Kuwait operates three Austal-built 22m patrol boats

BUILDING FUTURE FLEETS

**Austal USA is constructing a new wave
of advanced aluminium seaframes
to create a new-age navy**

The futuristic shape of *USS Independence* (LCS-2), the first Austal-designed and -built Littoral Combat Ship (LCS) for the US Navy, is physical testament to the fact that it is in the United States where Austal's advanced seaframe technology has made the biggest impact. Equally, as the world's largest aluminium warship, its radical form provides a powerful demonstration of the confidence placed in the company by the world's most powerful maritime force.

Independence is a truly transformational vessel, offering the multiple benefits of shallow draft, high speed, superior seakeeping, optimised aviation facilities, a modular open architecture mission system, and a large and reconfigurable internal mission deck. And all this it is enabled by trimaran hullform technology originally conceived by Austal for commercial service.

It was back in early 2000 that the company launched a programme of research and development with the objective to develop a new hull design that would deliver high speeds in rough seas while at the same time offering the seakeeping performance required to ensure the highest standards of passenger comfort. This work spawned a revolutionary 127 m trimaran design that, with the delivery of the ferry *Benchijigua Express* to Fred. Olsen, S.A. in April 2005, opened a new era in fast sea transportation.

Austal quickly recognised that the same aluminium trimaran technology offered huge potential in the military environment, affording the inherent advantages of large internal volume, flexible layout, shallow draft, more efficient powering and good manoeuvrability. Moreover, it gave the ability to carry a substantial payload at high speeds in a seaway without the loss in speed typically experienced with other hullforms.

What's more, tank testing and simulation has demonstrated that, in a wide range of wave conditions, the trimaran hullform offers improved seakeeping thanks to its ability to provide low transverse and vertical accelerations. This results in superior aviation and watercraft operational capability, and ensures that crew are less susceptible to fatigue or seasickness from ship motions, an even more important consideration as complements are downsized.

The US Navy's LCS programme has provided the first opportunity for Austal to bring its trimaran technology forward into the front-line. Conceived specifically to operate and fight in shallow water environments close to shore, the LCS will embark interchangeable mission packages to tackle threats as diverse as mines, submarines and fast attack craft. Furthermore, it will offer the capability to deploy independently to distant operating theatres and remain on station for extended periods. A class of up to 55 ships is planned.

What became apparent to the US Navy at the outset of the LCS acquisition effort was that requirements for

high sprint speed and outstanding manoeuvrability, without compromise to efficiency, range, seakeeping, shallow draft and high payload capacity, demanded a platform solution well outside the bounds of traditional steel warship design. So the service looked instead at alternative 'game-changing' approaches that emphasized the cost-effective pull-through of proven high speed vessel technologies accessible 'off the shelf' from the international marketplace.

Austal's pedigree shone through. Having participated in concept-level Focused Mission High Speed Ship studies, and with *Benchijigua Express* offering a design benchmark, the company's advanced aluminium trimaran was in 2004 downselected as one of two LCS seaframes. The keel of the first unit, *Independence*, was symbolically laid down at Austal USA's yard in January 2006.

The LCS trimaran seaframe is truly pushing the frontiers of naval vessel design. The slender center hull and two smaller side hulls gives the vessel the operational characteristics of a larger displacement craft, providing greater stability in rough seas and operational conditions.

Furthermore, the aluminium structure – certified by the American Bureau of Shipping for a 30-year service life based on a detailed spectral fatigue analysis – provides a capacious mission bay area offering superior role and mission flexibility, rapid reconfigurability, improved damage protection and ample margins for future growth. This translates into an inherently versatile combatant that adopts true open architecture principles so as to de-couple the platform and core mission system from the interchangeable modular



payloads it embarks according to its specified role.

Above the mission bay is the largest flight deck on any US Navy surface combatant. Capable of conducting dual H-60 helicopter operations and accommodating the CH-53 – the service's largest rotary-wing aircraft – this elevated aviation area benefits from reduced sea spray ingress as well as the inherently superior seakeeping performance of the trimaran so as to significantly expand the helicopter operating envelope in higher sea states.

A power-dense Combined Diesel and Gas Turbine (CODAG) main propulsion system comprises two MTU 8000 series diesel engines and two GE LM2500 gas turbines driving four Wärtsilä axial flow waterjets. This CODAG arrangement combines delivers an outstanding 45 knot sprint speed at full power, and extended range and fuel efficiency in an economical diesel-only cruising regime. What's more, the aluminium trimaran has a total installed power of just 62 MW compared to 84 MW on the smaller competing steel monohull seaframe.

Independence was launched on 28 April 2008 and, following extensive alongside testing of propulsion, communications, navigation and core mission systems, began first sea trials in early July 2009. A second and final series of builder's trials was successfully concluded on 18 October.

Construction of a first follow-on vessel, to be named USS *Coronado*, began in late 2009. Delivery is planned for 2012.

Alongside the LCS programme, the operational advantages offered by Austal's advanced high-speed seaframe technology have latterly been recognised by a joint-service endeavour that will fashion a new fleet of theatre logistics craft for the US Army and Navy. The Joint High Speed Vessel (JHSV) programme is intended to radically change the intra-theatre transport of medium-sized cargo payloads over water, capitalising on fast ferry seaframe technologies so as to cut costs, accelerate logistics delivery, and reduce reliance on shore-based infrastructure.

The result is a non-combatant vessel offering similar



Austal USA in Mobile, Alabama

Austal USA's facility in Mobile is currently undergoing a major expansion programme which, on completion, will double the yard's shipbuilding capacity. This latest investment in a state-of-the-art Modular Manufacturing Facility (MMF) marks the culmination of a decade-long strategy that has seen Austal carefully nurture the development of both production areas and skilled labour so as to confidently deliver a new generation of advanced aluminium seaframes to the US government.

Since its establishment in 1999, the Mobile site has gradually built up its expertise in the construction of aluminium ships, initially for the commercial market. This began with workboats and smaller cata-

marans, later stepping up to two 107 m Hawaii Superferry ROPAX catamaran ferries. Over that same period, the yard has benefitted from a significant and sustained programme of facilities investment.

The latest development at the Mobile yard is the construction of the new 70,000m² MMF on a 100 acre lot adjacent to the existing site. Phase 1 was completed in 2009, with Phase 2 to complete in 2011. The new facility will improve the efficiency of Austal USA's production processes, and provide the additional manufacturing capacity to allow the yard to handle a throughput of up to six large aluminium vessels – such as the LCS or JHSV – per year.



JHSV brings a new dimension to intra-theatre logistics

capabilities to a high-speed commercial ferry - and hence adopting commercial international survivability standards – but modified to incorporate a flight deck and aviation facilities, vehicle deck offload ramp and appropriate firefighting, C4I and force protection facilities. An initial buy of 10 JHSVs has been approved – split equally between the Army and Navy – with prospects for follow-on orders.

Following a competitive preliminary design phase, Austal was in November 2008 awarded a US\$185 million contract by the US Naval Sea Systems Command for the detailed design and build of the lead JHSV, with options for the build of up to nine additional ships, plus associated shore-based spares. The potential value of the 10-ship programme is estimated at over US\$1.6 billion.

Austal's unique experience of large aluminium multi-hull platforms enabled it to tailor a design that best met the JHSV performance and cost requirements. Given the weightings attached to key performance criteria, it developed a 103 m catamaran that leveraged a round-bilge, bulbous bow hullform refined from that already well proven by *WestPac Express*, and the same MTU 8000 diesel prime movers used in both the LCS and numerous commercial vessel programmes.

The result is an affordable and low-risk platform, designed to ABS High Speed Naval Craft code, which meets the JHSV objective mission and aviation requirements with structural and operational reliability. Stand-out features include the ability to transport 700 tons of payload over 1,200 nm at an average speed of 35 knots, 3,500 nm range, a 2,000 m² mission deck for vehicles and cargo, organic cargo handling facilities, and the capability to operate a CH-53 helicopter from a flight deck aft. Furthermore, alongside accommodation for the 41 crew, the JHSV will be able to berth up to 150 in maximum load conditions, with additional airline-style seating for a force of 312 troops.

Austal's principal partner is General Dynamics Advanced Information Systems, which, as Platform Systems Engineering Agent, will design, integrate and test the JHSV's electronic systems, including an open architecture computing infrastructure, internal and external communications, electronic navigation and self-defence systems. It is also taking responsibility for the flight deck arrangements, including lighting and visual landing aids.

Following the successful conclusion of Production Readiness Review, Austal USA began the build of *Fortitude*, the first JHSV, towards the end of 2009 with delivery scheduled for 2011. Options for long lead time materials for the next two vessels, *Vigilant* and *Spearhead*, have already been exercised.



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