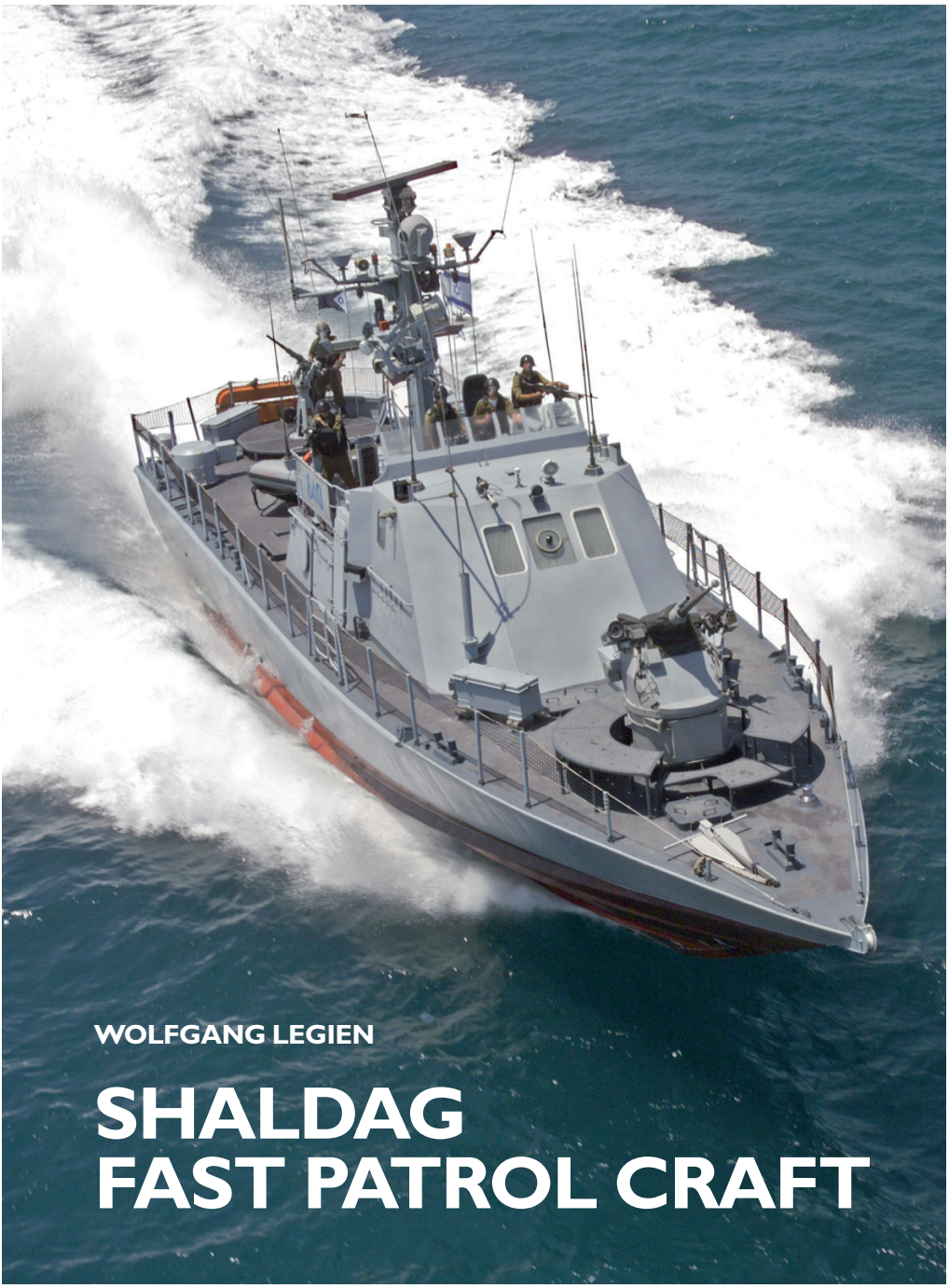

Fig. 1: SHALDAG – Full power on sea. (All photos courtesy of Israel Shipyard Ltd.)

WOLFGANG LEGIEN

SHALDAG FAST PATROL CRAFT

The SHALDAG is a combat proven vessel serving the Israeli Navy and other navies and security forces for many years with the full satisfaction of customers. The SHALDAG is successfully serving in Europe, Asia and Africa and it is also marketed in Latin America, where Israel Shipyards has ongoing negotiations with potential customers. Commander Israeli Navy (ret.) **Avi Shahaf**, provides details of the ship's genesis, role, design, ship data, propulsion, sensors, armaments and other payload, and he answers questions of NAVAL FORCES Editor-in-Chief.

GENESIS

The initial detailed design was developed by Israel Shipyards Ltd, as a result of the Israeli Navy (IN) needs for a fast patrol craft for protecting the Israeli coast against the increasing terrorist threat. The design was carried out at the end of the 1980ies, due to the fact that Navies were looking for new and improved solutions for the increasing threats to assets along the coast and for offshore facilities.

The protecting naval forces recognised that there was a global shift from local wars into 'low intensity conflicts'. At the same period also the technology of drilling at sea for oil and natural gas was developed and the need to protect offshore facilities and assets emerged.

The operational requirements were defined by ex-Israel Navy officers that were employed at Israel Shipyards under the management of Admiral Ze'ev Almog (retired Commander of the IN), who all were well familiar with the IN needs. They have closely followed the development stages for ensuring a positive outcome.

The SHALDAG was developed and built by Israel Shipyards Ltd. (ISL), and was upgraded several times over the years based on combat experience gained. The original design was aiming at the '50-50' formula, which means 50 tons displacement and 50 knots speed. Since at the time of development there was no similar craft that could reach the 50 knots speed, there was a need to construct a proto type. The first SHALDAG MK I was therefore built in 1989 and launched in 1990 to answer the concept of fast and highly manoeuvrable craft, self financed by ISL.

Intensive series of sea trials were carried out to confirm that the defined performance was indeed achieved. Over the years, and due to different customers' requirements, the full load displacement increased to 58 tons and speed decreased to 47 knots.

ROLE

The SHALDAG Fast Patrol Craft is designed to serve as a naval vessel as well as a Border Police ***(see figure 2)*** and Coast Guard unit. It is a combat proven craft, designed for coastal defence and security, where high intercept speed and immediate response are required.

The SHALDAG mission roles include:

- terrorist activities interdiction;
- coastal and internal waterways defence against illegal activities and smuggling of drugs and/or armaments;
- interception of hostile vessels;
- fishery control;
- protecting natural resources against unauthorised exploitation;
- preventing illegal immigration;
- offshore facilities protection;
- search and rescue operations;
- detecting and fighting sea pollution.

DESIGN

The craft is designed with outstanding performance requirements in mind:

- high acceleration enables the SHALDAG to reach the speed of 40 knots in about 40 seconds, and high speed in rough seas – in order to be faster than the targets;

- outstanding manoeuvring performance such as a turning diameter of about 150m at a speed of 40 knots, and to be able to quickly respond to an evasive/firing target;
- excellent sea keeping characteristics such as very low slamming in all weather conditions, also to reduce crew fatigue and to improve crew response abilities and firing;
- dry deck at all speeds for easier crew movement at sea;
- easy to operate and maintain;
- high reliability with very low failure rate;
- very shallow draft, in order to approach the shore, and even beach it if required.

Therefore the SHALDAG was built as a fully-planing deep-vee, hard chine craft with minimum resistance even in rough seas, with a powerful propulsion system comprised of two diesel engines and two water jets. A huge effort was invested in choosing the best propulsion system.

Compared to surface propelled vessel the water-jet is more suitable for coastal defence missions. Main advantages are:

- no exposed propeller to hit underwater objects;
- lower noise and vibration level;
- no cavitation, even at very high speeds;
- the water-jet impeller is made of stainless steel, stronger than the CuNiAl or NiAl bronze propellers;
- the manoeuvrability of a water-jet propelled boat is significantly better, due to the high side thrust vector generated by the steering bucket;
- to change from 'ahead' to 'astern', there is no need to disengage the gear, and therefore no change of the rotation direction of the gearbox. The change is done much faster and smoother, without need to stop the shaft;
- water-jets are designed to absorb maximum engine power at any boat speed, which results in longer engine life;
- reliability and lower maintenance requirements.

Over the years ISL have developed various types of the SHALDAG (MK II – MK V, ***see figure 3***), as a result of gained operational experience and according to customers' requirements. Constant improvement of the platforms was a practical path through a continuous com-

SHALDAG: SYNONYM FOR AN UNSURPASSED 'TAILOR-MADE' FAST PATROL CRAFT

Avi Shahaf
(Commander Israel Navy ret.) served in the Israeli Navy between 1968 and 1989 in various sea and HQ duties, as Commanding Officer of a Sa'ar-4 missile boat, and as Flotilla Commander of Fast Patrol Boats. From 1989 he was Marketing Manager at Israel Shipyards Ltd. (ISL) and took up his present position as General Manager ISL. He holds a BA in Economics and Business Administration of the University of Haifa.

NAVAL FORCES: *What was the idea behind developing the SHALDAG?*
AVI SHAHAF: The need for a fast Patrol Craft with very good manoeuvrability was raised as a result of the world-wide change from regional and local wars to low intensity confrontations, and the increase of the terror threat. The common scenario was that the intruders were trying to hide their intentions and become part of merchant or fishing boats in their region. Due to these tactics, the protective vessel needed to get very close for positive identification, and then it was exposed to their fire, as they were in a position to be the first to open fire at close range. Hence there was a need for a very fast craft, with high manoeuvrability that has a very high ratio of firepower to displacement, for facing such challenges and offering very fast reaction. The SHALDAG gave the answer to these needs and changes of doctrines of coastal defence.

NAVAL FORCES: *What was the deciding factor for selecting a water-jet vice water piercing propellers?*
SHAHAF: A huge effort was invested in choosing the best propulsion system. Compared to surface propelled vessel the water-jet is more suitable for coastal defence missions. Some of the advantages are: (1) No exposed propeller to hit underwater objects; (2) lower noise and vibration levels; (3) no cavitation (if the size is properly chosen); (4) the manoeuvrability of a water-jet propelled boat is superior; (5) water-jets are designed to absorb maximum engine power at any boat speed, which results in longer engine

Fig. A: The SHALDAG is constructed as a 'tailor-made' craft and it is servicing different types of coastal defence units, such as Navies, Coast Guards, Border Police (Romanian Border Police SHALDAG seen here), Marine Police, Customs.

Fig. 2: The SHALDAG Fast Patrol Craft is designed to serve as a naval vessel as well as a Marine Police (Romanian Border Police SHALDAG seen here) or Coast Guard unit.

bat experience feedback from the IN and other users. The craft is capable to operate up to sea state 4 with reduced performance and survive up to sea state 6. Power is provided by two high speed diesel engines, which drive two water-jets incorporating steering and reversing gear. Propulsion machinery is located aft. The hull is divided by four structural transverse watertight bulkheads (in some designs five bulkheads). The main boat compartments are arranged as follows:

- fore peak;
- ammunition store & sanitary spaces;
- accommodation for 10-14 crew members;

life avoiding engine overload; (6) reliability and lower maintenance requirements.

NAVAL FORCES: *It is understood that the SHALDAG comes in various designs, like an open bridge aft of the command centre. Does this indicate that the customer is free to select superstructure and internal deck configuration?*
SHAHAF: Indeed, the SHALDAG is constructed as a 'tailor-made' craft and since it is servicing different types of coastal defence units ***(see figure A)***, such as Navies, Coast Guards, Border Police, Marine Police, Customs. It is designed to fulfil different requirements. The SHALDAG is adjusted to the exact needs of each user. The adjustment can be done in terms of superstructure type, armament options, navigation and communications equipment, accommodation design, number of crew members, and any other item.

NAVAL FORCES: *Would it be possible to arm the SHALDAG with a small ship-ship missile system including a suitable sensor/director, vice the TYPHOON gun with the search radar and electro-optical director carried?*
SHAHAF: Yes, it is possible to arm the SHALDAG with additional components of weapon suite such as short range missiles. It can be positioned on the aft deck and be directed from the bridge with a suitable sensor. These short range missiles can serve for attacking targets at sea or on the coast line. It was already done successfully by the SHALDAGs operated by the Israeli Navy.

NAVAL FORCES: *What makes the SHALDAG a leading design in the field of Fast Patrol Craft?*
SHAHAF: We believe that the SHALDAG is the best design for Fast Patrol Craft, due to its very high speed, excellent manoeuvrability, exceptional seakeeping, and the ability to carry up to 6 tons of combat payload. It is a combat proven vessel that is constantly upgraded based on gained experience and feedback from the users. Also the contribution of the advanced Israeli Defence Industries helps making it the best available solution for coastal defence. At the same time the maintenance of the SHALDAG and its systems is relatively very simple and the craft is designed to be low-maintenance.

NAVAL FORCES: *What does the SHALDAG 'package' include?*
SHAHAF: The SHALDAG is offered to customers as a 'full package' that includes training for the operational and maintenance crew. The 'full package' includes planned maintenance programme (crew and depot levels), spare parts, documentation and drawings. The training is done by ex-Israeli Navy officers and is offered at the ISTC (Israel Shipyards Training Centre) and at the suppliers of main systems facilities.

NAVAL FORCES: *Is there any need for extra protection/armour of the SHALDAG against bullets?*
SHAHAF: The SHALDAG is a very fast craft with exceptional manoeuvrability. Add to these the fact that the SHALDAG's armament is for ranges of above 2,000 yards, our doctrine is that there is no need for extra protection or armour. The SHALDAG can be operated in a way that will keep it away from the target's firing range which is the best way to protect it ***(see figure B)***.

Fig. B: The SHALDAG is a very fast craft with exceptional manoeuvrability. Add to these the fact that the SHALDAG's armament is for ranges of above 2,000 yards, our doctrine is that there is no need for extra protection or armour, says the General Manager of ISL.

At the same time, if a customer insists on protecting main equipment, this can be considered.

NAVAL FORCES: *Mr. Shahaf, thank you very much for your detailed description of the SHALDAG, a product ISL and its users can be proud of.*

- auxiliary room (in some models);
- engine room;
- water-jet and steering compartment.

The hull and deck house are built of marine aluminium alloy welded construction with excellent corrosion-resistant characteristics. Scantlings are in accordance with Lloyd's Register Rules. The use of aluminium helps significantly in reducing the weight of the craft. It is worth mentioning that construction of craft made of 100 percent aluminium demands a very high level of professionalism, skill and experience – ISL has decades of experience in this field.

The hull is shaped with smooth lines both above and below the water line, offering exceptional handling even at high sea state ***(see figure 4)***.

The hull watertight subdivision and compartment arrangement provide the ability to survive underwater damage of any compartment. The main deck is continuous. The deckhouse includes wheelhouse, mess room and galley. The open bridge is located above the closed bridge and includes a helmsman position and ship controls.

The fact that the length-to-breadth ratio of the vessel is relatively low is one of the design factors that provide high stability for the craft compared to similar boats. Other factors that contribute to the vessel high stability are: a spray rail, hard chine hull, and a relatively low centre of gravity.

The boat is designed according to the Rules and Regulations of Lloyd's Register of Shipping.

Main propulsion is provided by two MTU 16V2000 or 12V4000 diesel engines driving two MJP 550DD or 650DD water-jets; these two drive trains can be operated independently. In the past, the vessels were equipped with Deutz MWM 620V16 engines and LIPS or KaMeWa water-jets. The reasons for the changes in types of propulsion system are mainly customers' requirements and the need to adjust accordingly. The control of the propulsion system is from the wheel house and fly bridge with a capability to be controlled locally from the engine room. The efficiency of the water-jets was significantly improved over the years, and currently better results with smaller and lighter jets are achieved. It is important to re-iterate that the jets are helping to achieve low maintenance levels for the craft.

The **sensor suite** consists of a surface search X-band radar for navigation and surveillance. Another standard sensor used on most of the SHALDAG Fast Patrol Craft is the multi-sensor stabilised electro-optical director for day and night surveillance. It can be either the TOPLITE™ supplied by Rafael, POP™ supplied by IAI, or any other light-weight E.O.D., and is used for surveillance and fire control of the main gun. It includes colour CCDs, generating visual and thermal images for day and night operations, accurate line-of-sight positioning, laser rangefinder, tracker and designator.

The **Integrated Navigation System** with 24 VDC supply includes the following features: GPS receiver and antenna; Echo-Sounder; AIS (Automatic Identification System), complete system with transponder, display, VHF/GPS antenna; Navigation radar (X-band); ARPA module; display of electronic maps; multi-function 15" display units for the wheel house control console.

Concerning the **armament suite**, traditionally ISL is offering naval vessels with high fire power for a relatively low displacement. The SHALDAG is fitted with the required foundations to enable installing fore-deck and aft-deck guns, as well as heavy machine guns on the fly bridge (port and starboard) and / or on the deck. The guns can be either the remotely controlled and stabilised TYPHOON or Mini-THYPHOON guns, or manually operated guns and machine guns. Of course a mix of both is also possible. Based on the above, the vessel can be **optionally fitted** with the following armament:

- 1x TYPHOON-type automatic stabilised and remotely controlled 23/25mm gun, *or* similar manual naval gun;
- 2x 12.7/ 7.62mm MINI-TYPHOON type automatic stabilised and remotely controlled heavy machine guns, *or* manual machine guns, on the fly bridge;

Fig. 3: There are hardly two SHALDAG alike, with remotely controlled or manual main gun systems forward, gun or other equipment aft, different fly-bridge configurations, different boat length – they come as SHALDAG MKII to MKV, in Navy, Coast Guard, or Border Police configurations.

Fig. 4: The SHALDAG's deep-vee hull is shaped with smooth lines both above and below the water line, offering exceptional handling even at high sea state.

SHIP DATA, PROPULSION, AND PAYLOAD

SHALDAG MKII

Length, overall	24.80m
Beam, moulded	6.00m
Draft, max.	1.15m
Speed, max.	45 knots
Displacement	58 tons
Crew	8 - 10
Range @ 33kn	650nm
Endurance (days)	4

SHALDAG MK III/IV

Length, overall	26.70m
Beam, moulded	6.00m
Draft, max.	1.20m
Speed, max.	43+ knots
Displacement	64 tons
Crew	10 - 12
Range @ 33kn	700nm
Endurance (days)	4

SHALDAG MK V

Length, overall	31.20m
Beam, moulded	6.40m
Draft, max.	1.25m
Speed, max.	40+ knots
Displacement	95 tons
Crew	12 - 14
Range @ 33kn	1,000nm
Endurance (days)	6

- 2x 12.7 / 7.62mm manual machine guns on the aft deck;
- 2x 12.7/ 7.62mm manual machine guns on the main deck on the sides of the deckhouse (one on each side);
- 1x 20-23mm naval manually operated gun mounted on the rear gun foundation near the transom;
- 4-8 short-range 4-8 missiles (IAI LAHAT or equivalent).

The SHALDAG is fitted for **optional payload alternatives**, depending on customer's requirements. This includes a suitable boat, such as a 3.20m ZODIAC MK II or RHIB. The RHIB is up to 5.20m and can be either a rescue boat of an approved type, or a fast patrol boat. When a RHIB is supplied the vessel includes a lifting and launching davit. 13,000 litres of fuel are carried, and 1,000 litres fresh water (the MK V also has a desalination plant).

SUMMARY

As of today, the SHALDAG is constructed on a 'tailor-made' basis in order to give full response to any customer's needs. The accommodations of the craft are also adjusted to the exact number of crew members of each user and to the level they are defining.

The accumulated combat experience and feedback helped in designing and executing a large number of improvements over the years. The hull was lengthened and was modified to specific requirements of the Israel Navy as well as other customers. Adjustments were also made to the superstructure. NAFO