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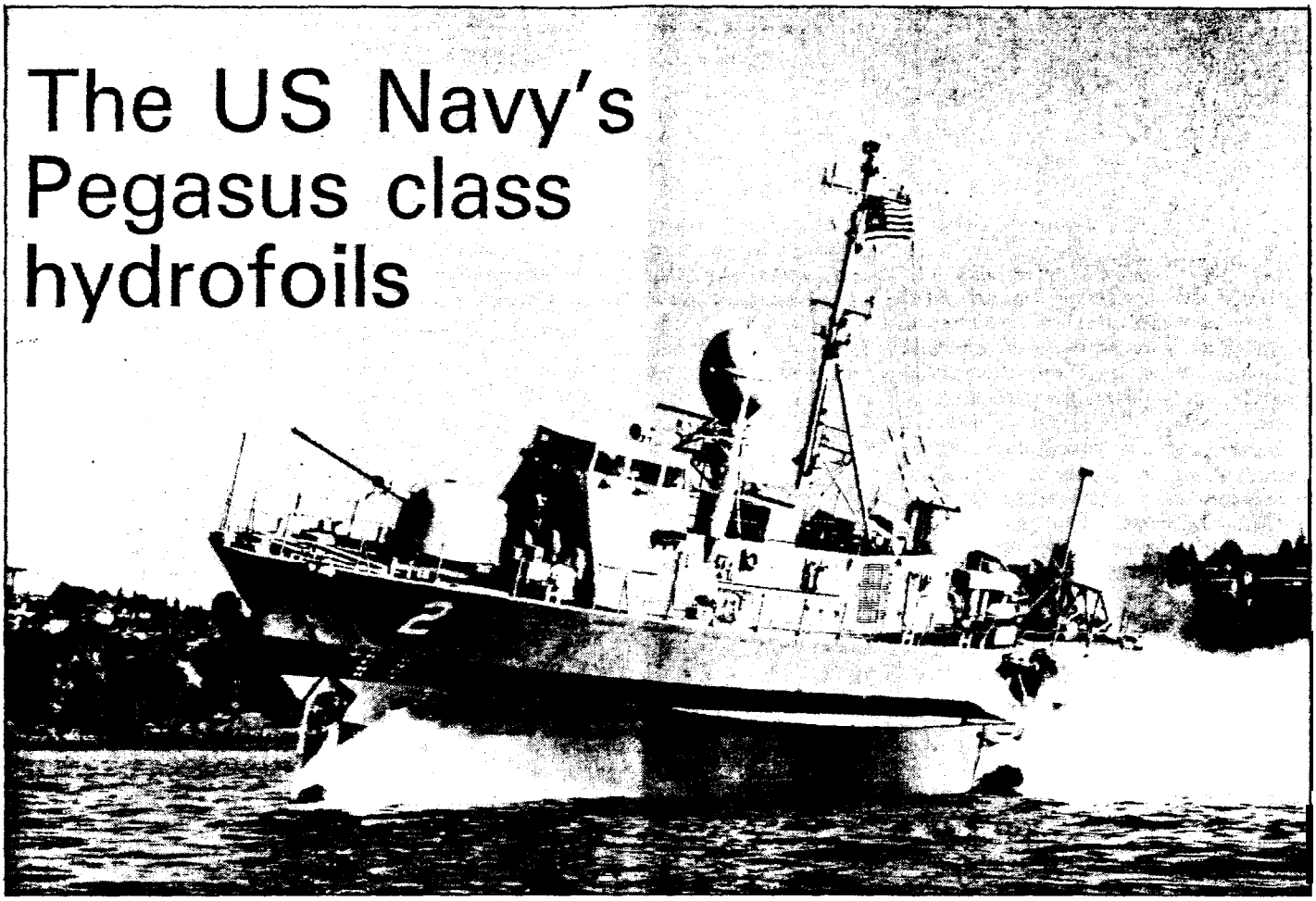
The US Navy's Pegasus class hydrofoils



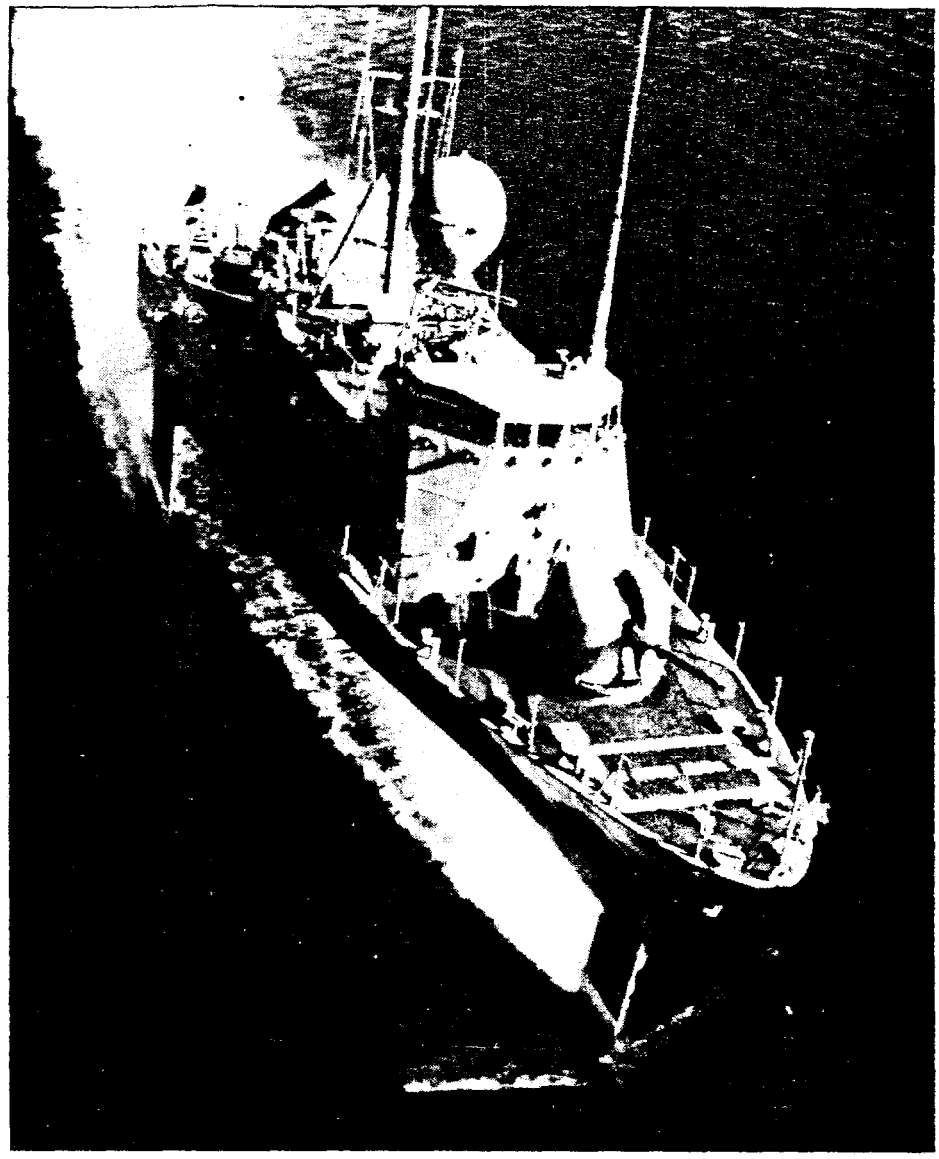
▲ *The USS* **Hercules** *IPHM-21 heels during a tight* **turn, while on** *trials* **out of Boeing Marine's** *Seattle facility The 76 mm Mk 7.5 gun is installed but* **nor the** *Harpoon missiles*

THE US NAVY is one of two countries in NATO, the other being Italy, actively to employ a class of hydrofoils in a combatant role. This class is the Pegasus class Guided Missile Patrol Combatants (Hydrofoil) (PHM). Consisting of six units, the class, its parent command Hydrofoil Squadron Two (PHMRON 2), which consists of three officers and nine enlisted men and a Mobile Logistics Support Group (MLSG) of six officers and 107 enlisted men, is based at the Trumbo Point Annex of the Key West Naval Air Station. The six units operate as a homogeneous squadron, developing tactics and expertise with the hydrofoil. They also participate in exercises, conduct reconnaissance and 'show the flag'. *Jane's Defence Weekly* was invited to visit the USS *Gemini* (PHM-6) for a private tour to examine closely a member of this controversial class. The PHM concept began as a co-operative effort between the governments of the USA, West Germany and Italy in an effort to produce a patrol combatant that would be acceptable to all NATO countries. Out of this was born the PHM. The armament was to be supplied by Italy, the fire control by The Netherlands, the main propulsion by the USA and the auxiliary propulsion by West Germany. Germany subsequently withdrew, but the programme continued in the USA and Italy.

The two prototypes of the class, subsequently named *Delphinus* (renamed *Pegasus* on 26 April 1974) and *Hercules*, were authorised under the FY71 R&D programme. *Pegasus'* keel was laid down on 10 May 1973, followed by that of the original *Hercules* on 30 May 1974. With high inflation, and design and other problems, costs began to increase rapidly. By August 1975, it became evident that there were not enough funds to finish both ships. Construction of *Hercules* was thus suspended (she was 40·9% complete) and all funds were directed to completing Pegasus. The armament and fire-control systems ordered for *Hercules* were put into storage. *Pegasus* was finally launched on 9 November 1974 and made her first foil-borne trip on 27 February 1975. During these problems with the two **prototypes,** the US Congress had demonstrated faith in the programme by approving funds for the construction of four more units (PHM-3/6) under the FY75 Shipbuilding and Construction programme. It then proceeded to provide funds for completion of *Hercules* under the FY76 programme. The total appropriated was $272·1 million. On 6 April 1977, Defense Secretary Harold Brown 'reevaluated the programme and cancelled it. There had been some initial problems with the pumps, gear-box and electrical system on *Pegasus* which, however, had been overcome after initial trials. *Pegasus* was to be retained as a high speed test and evaluation platform and to operate in much the same way as *High Point* (PCH-1) now operates. Here, however, the US Congress stepped in. Since the funds had already been appropriated, Congress had to do and, after much pressure, Secretary Brown released the funds in August 1977 and the programme proceeded its full course (see Table 1 for construction data of the class). Unfortunately, in the four month interim, the incomplete hull of the *Hercules* had been scrapped. On 20October 1977, acontract to 'rebuild' *Hercules* and construct PHM-3/6 was let to Boeing Co, Seattle, Washington.

Initially, it was planned that Gemini (PHM-6) would be unarmed because there was only enough funding to purchase armament and fire-control systems for PHM- 2/5. During 1982, the fire control and armament of the original Hercules was discovered in storage in a Boeing warehouse. It was removed, refurbished and installed in *Gemini* in early-1983. *Gemini* would have otherwise been employed in the role originally planned for *Pegasus*

Every inch of space is used on board *Gemini* and the ship is configured for minimal manning. For example, when under way the engineering spaces are unmanned. For a small ship' it has all the latest technology on board that it can use. Space is so limited that the *Pegasus class is* the only class of US Naval ship that has a combined wardroom and crews' mess. The engineers' operating station has a **very large** control panel which duplicates the flight engineers' station on a Boeing 747 aircraft. **At** this position the watchkeeper can monitor the



This aerial view of the Aquila (PHM-4) shows her compact layout. The Harpoon missiles are not yet fitted, and the canisters are merely to provide equivalent weight during trials

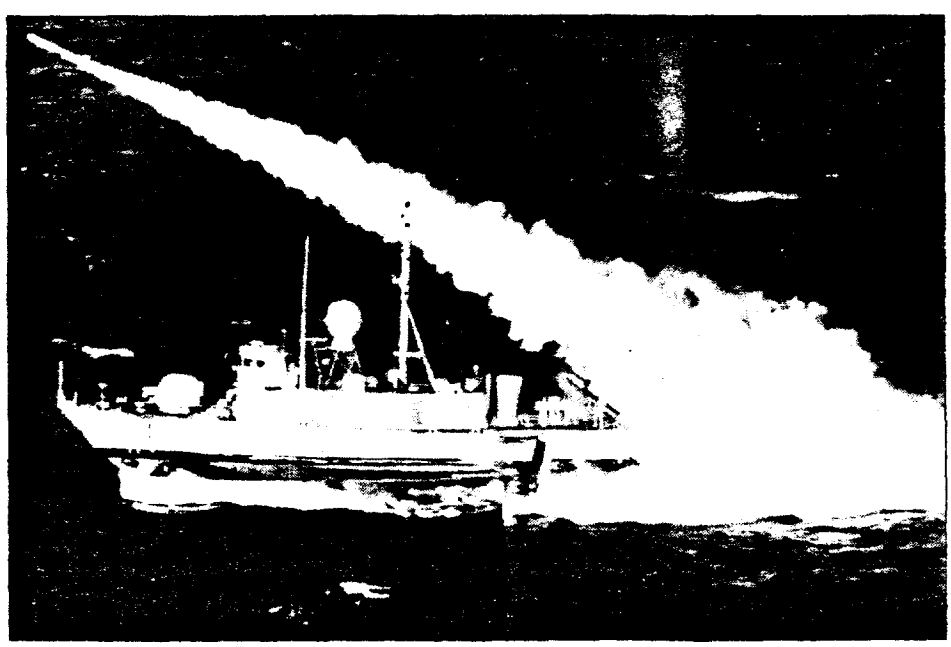
electrical and auxiliary systems. From this position, the ship's foils are lowered when it is time to 'fly'. Further, one of the more interesting shipboard auxiliary systems is operated from here: the automatic control system. When set, it acts as an echo-sounder and keeps the hull, when on foils, above the highest wave it encounters as it automatically adjusts its height as the ship proceeds. The inputs required are mode-selection (manual or automatic), foil depth setting, foil-borne throttle setting and steering.

Proceeding further, a hatch leads to the engine room where the LM-2500 is the most dominating feature hanging from four hydraulically operated shock absorbers and supported from below by four more. It was discovered by experience that when the turbine is working the vibrations are absorbed by the hydraulic supports rather than being transferred throughout the ship, as would be the case in an engine mounted on the hull supports in geared turbine powered ships. Two-thirds of the turbine are located in this compartment, the rest runs through a bulkhead that leads to the **after**-most compartment in the ship. The LM-2500 gas turbine is a **marinised** version of the type of engine used on a Boeing 747 aircraft. It provides the power, through the middle of the transom, for the Gemini when she is flying on her foils. The lifetime of the turbine, between overhauls, is rated at 1000 hours. However, they are often run much longer; the ***Gemini*** still carries her original turbine. Underneath the turbine, next to the after bulkhead, is the foil-borne gearbox.

The aftermost compartment of the ship has the final third of the gas turbine over the **keel** and exiting through the transom where the engine thrust is expelled to provide **foil**-borne power. On each side of the turbine are mounted, in conventional fashion, MTU diesels. Our guide, the Main Propulsion Assistant, informed us that the diesels were very efficient and reliable. However, there was one problem. Parts and other necessary supplies to keep the diesels operating had to be purchased from West Germany as the US Navy supply system does not keep them in stock. Hence, delivery time can be several months or more. It was interesting to learn that Boeing Co, as part of the construction contract, stockpiled a great quantity of supplies for the diesel engines, but the navy refuses to go directly to Boeing to get the supplies needed.

Below the exhaust and mounted on each side of the transom are the two **hullborne propulsors** which are Aerojet waterjets. They also act as the rudders by **swivelling**, in tandem, 180" from beam to beam. In either after corner of the compartment is the hydraulic system for lowering or raising the after foils.

The Combat Information Centre (CIC) is on the main deck in the superstructure, immediately above the mess and officers' quarters. As configured the **CIC**, among other things, accommodates the Harpoon missile fire-control system, the US Mk 92 fire-control system for the 76 mm OTO Melara Compact gun forward, an **AN/SRN-17** Omega navigation system, a dead reckoning tracer (DRT), which is also used as a chart table, a speed log, a depth sounder/recorder, a hydrofoil collision avoidance and tracking system (HYCATS). two radar repeaters, an integrated intercom/announcing/exterior **communications** access system, an AIMS Mk 12 IFF system, an ESM system and an integrated shipboard



A vivid demonstration of the striking power of a missile-armed hydrofoil, as the prototype Pegasus (PHM-1) fires a Harpoon anti-ship missile

communications system. One of the most unusual systems used in the CIC is a TV camera that hangs immediately over the DRT. When the navigation charts or the DRT are being used to convey the strategic and tactical situation, the image is reproduced on a TV screen on the bridge mounted on the left of the steering console in front of the Officer of the Deck. Also in the CIC is a small separate compartment which is used for radio central. Due to its classified nature, the room was prohibited to us, but it was explained that in the compartment are HF, UHF, VHF communications gear, an AN/SSR-1 satellite communications receiver, an AN/WSC-3 satellite communications transceiver and two teletypes (KW-7/KW-8 Series).

The bridge configuration is unique among US Navy ships. Firstly, it has a 360° radius view. Secondly, the steering console resembles an aircraft cockpit. There are three seats in front of the console: to the left sits the officer of the Deck, to the right the helmsman who handles the steering and engineering order telegraph, and immediately behind and in the middle of the two is the Captain's seat. When the ship is up on foils, all three have to be strapped in and no-one is allowed on deck. Immediately behind the bridge are the 01 level, where the Mk 92 tire-control antenna is mounted on top of a quadrapod mast, the mainmast itself, and two Mk 34 Chaffroc launchers. An instant recognition feature, other than the hull number, between ***Pegasus*** and the rest of the class is that ***Pegasus'*** radar antenna is mounted on the mainmast.

Descending to the main deck, we examined the 76 mm OTO Melara Compact gun that each unit carries. Manufactured in the USA under licence from Italy, the gun initially caused the navy problems by constantly jamming. The automatic loading system would be slightly too fast, causing the system to try and put a shell in the gun when the breechblock was closed. This usually happened every five or six rounds. Now, the problems have been solved and the gun is a very reliable weapon. Proceeding aft to the stern we saw four Harpoon missile canisters mounted in twin pairs. Ships of this class can carry a maximum of eight fitted in two quad mounts. Hanging over the stern, just aft of the Harpoons, were the after foils. Both these foils, joined amidships, and the single foil forward, are all stainless steel and, as mentioned previously, are lowered and raised by a hydraulic system. They can be raised at any speed higher than 9 kt.

The PHM carries the clout of a major combatant, yet it is extremely agile and its turning rate cannot be matched by any other US Navy ship. Further, the PHM can conduct operations in rough seas at speeds over 40 kt. The PHM is a type of ship that the navy needs and it is hoped that from lessons learned from operations with the ***Pegasus*** class, the US Navy will go on to construct better hydrofoils of this type.

Table 1
Pegasus class construction data

Name	*No*	*Lad down*	*Launched*	*Commissioned*
Pegasus	PHM-1	10 Mav 1973	9 November 1974	9 July 1977
Hercules	PHM-2	1 2 September 1980	13 April 1982	15 January 1983
Taurus	PHM-3	3(January 1979	8 May 1981	10 October 1981
Aquila	PHM-4	1(July 1979	16 September 1981	*26* June 1982
Aries	PHM-5	7 January 1980	5 November 1981	11 September 1982
Gemini	PHM-6	1; May 1980	17 February 1982	13 November 1982

Table 2
Class characteristics

Displacement 241.3 tons ful:. load
Dimensions (foils extended) 132 9 ft (40·5 m) oa x 28·2 ft (8 6 ml hull; 47-5 ft (14 5 ml over foils x 23 2 ft (7·1 m)
(foils retracted1 145.3 ft (44 3 ml oa x 28-2 ft (8·6 ml hull x 7·5 ft (2·3 m) extreme
Missiles SSM; 8 Harpoon in single canisters arranged in 2 mounts
Gun 1-76 mm/62 Mk 75 (400 rds total carried)
Main engines (foil-borne) 1 gas turbine (General Electric LM-2500); 1 B 000 shp, 2 Aerojet waterjet propulsion units=48 kt max speed (up to Sea State 5)
(hull-borne) 2 MTU type 8V331 TC81 diesels; 1630 bhp, 2 Aerojet waterjet propulsion units = 12 kt
Range 1700 miles at 9 k; 700 miles at 40 kt
Fuel **5C** tons (62 000 l: JP-5/diesel (JP-5 preferred!
Complement 4 officers. 1 9 eniisted men
Electronics (surface search radar) AN/SPS-63
(fire control) US Mk 92 (except PHM-1 which has the originai WH-28)
[satellite communications) OE-82 antenna, SSR-1 receiver, WSC-3 transceiver
Rockets 2 Mk 34 Super RBOC Chaff launchers (24 cartridges total)

▼ *The bridge layout of rhe PHMs is reminiscent of an aircraft cockpit, and reflects the extent to which Boeing used aerospace-derived technology*