

# BOEING MARINE SYSTEMS

by

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This is a Four Part series of my experiences, observations and comments of my 25 years with BMS as a test engineer and manager from 1962-1987. All personal comments are my own and do not reflect the opinions of other employees or the Boeing Co.

## PART 2

### JETFOIL EVOLUTION

In the later part of 1973, I was assigned to the Jetfoil program as test manager. The test group was responsible for writing all of the test documentation. This included hydrostatic, functional, dockside and underway test procedures for all Jetfoil boats. The Jetfoil was intended to reflect Boeing's hydrofoil expertise based on the Tucumcari's successful design and performance, but it fell short in several areas. The Jetfoil was designed by Project Group and not the Engineering Staff which was responsible for the PGH-2 design. The Jetfoil concept was the brainchild of Bill Shultz, Chuck Coffee and Bob Gorenstein who along with the Sales Group sold five boats for \$3.5 million each on paper based on their design. Three Jetfoils were sold to PST (Pacific Sea Transport) Seaflight in Hawaii, and two short strutted boats to FEH (Far East Hydrofoil) in Hong Kong.

My first impression after previewing the Jetfoil drawings was a bit of a shock to see that this design was contrary to what Boeing spent the last 10 years in development of state-of-art hydrofoil technology. The foils and propulsion system configuration were not like Tucumcari. The foils were thick and in rectangular shape which was unlike anything I had ever seen while testing hydrofoil models at Boeing. The propulsion system configuration which was the heart of the overall performance of the boat, was again nothing like Tucumcari, in fact it was just the opposite. The PGH-2 propulsion configuration had two inlets (one on each aft strut) and one turbine and pump. Either inlet could supply enough water to the pump, so if one inlet un-wetted or got plugged the other inlet kept supplying water to the pump. Any debris that went through either inlet went completely through the pump and nozzle. On the other-hand after review of Jetfoils inlet, pump and nozzle clearances the propulsion system could have potential problems. Jetfoil had one inlet (center strut and extra drag) and two pump/ turbine combinations. When the inlet un-wetted, both turbines had the potential for shutdown. Any debris that went through the inlet could get stuck on the hull-strut interface grate or passed through the grate and get stuck in the pumps or nozzles. This basic design fault later caused many schedule delays, degraded rough water performance and created high maintenance costs. One other thing that was a safety problem was the stairwell to the upper deck that faced the wrong way as many passengers and crew were thrown down the stairs into the bulkhead on the lower deck during rough water causing many injuries, some serious. Why these basic design deficiencies weren't pondered in the design phase is a mystery to this day since I and many other BMS employees stated their concerns as early as 1973. When my team of test engineers were writing the test procedures we inquired and asked questions about our concerns but we were told that the boat had already passed

the design approval stage and the configuration could not be changed.. This answer did not alleviate our concerns about design limitations that might effect boat performance during future underway operations. This put all BMS test personal at odds with project group and sales department throughout the whole Jetfoil program.

The first Jetfoil keel was laid down in the winter of 1973 and the first launch was in April of 1974 at the Renton BMS Facility at South end of Lake Washington. After several months of dockside and hullborne testing Jetfoil 001 was ready for it's first takeoff. Several attempts were made during trials in June but were unsuccessful. Changes were made to the takeoff controller, new nozzle and hull trim tabs were added before the first takeoff was finally accomplished in July. Jetfoil 929-100-001 was to be used for initial testing and had no interiors except for some used seats for the test crew. A few initial foilborne tests and demonstration runs were made on Lake Washington before we transited to Elliot Bay and the BMS facility at Pier 91 in Seattle. Except for the ACS (Automatic Control System), all basic systems were in the production configuration. Water barrels were used for ballast to simulate weight and balance for various fuel and passenger loadings. Initial calm water testing of a new hydrofoil design are intended to determine vehicle behavior relative to the design criteria. On a new boat such as Jetfoil testing is equivalent to a new aircraft. The scope of calm water testing was to verify both hullborne and foilborne performance envelopes and at times was rather boring. Several months of calm water testing included 144 trials for propulsion, hydrodynamic drag and foil incidence angles changes for optimum performance. Test were also conducted on the pre-production ACS and on production ACS after it was installed. By December 1974 we were ready to move on to rough water testing. During the transit to rough water in the Strait of Juan de Fuca we encountered large swells and the turbines shut down several times before we returned to Pier 91. No surprise, but it was worse than I expected, and it was a serious delay to the test program while everyone regrouped to solve the problem. Two fixes were installed, a TUPS (Turbine Unloading Protection System) and a "contouring" mode which increased the response to wave encounters and vertical accelerations that degraded ride quality. The fixes helped foil broaching and inlet un-wetting enough to define the rough water capabilities. Jetfoil was basically a 40 knot sea state 4 boat and not the advertised 45 knots in 12 foot waves. Jetfoil testing on boat 001 ended in February 1975 and returned to Renton for refurbishment and interior installation. Meanwhile boat 002 which was the first of two short strutted boats for FEH was under going builders acceptance and Coast Guard certification trials. Boat 002 the "Maderia" was accepted by FEH in February 1975 and commenced service between Hong Kong and Macao in April of 1975. In March 1975 boat 003 began testing, certification and builders trials for PST.

The "Kamehameha" commenced inter- island service in Hawaii in June 1975. Boat 005, the "Santa Maria", the second and last short strutted boat was delivered to FEH in June. Before delivery we ran a short demonstration run for Georgian Gulf Cruises from Victoria to Vancouver Canada. Jetfoil 001 the "Kalakaua" the refurbished test boat was delivered in August and 004 the "Kuhio" in September 1975. BMS test personal in Renton and Seattle were working 10-12 hours a day and often 7 days a week. The BMS SST (Ship System Test) organization that was created in 1974 and was comprised of two test teams with Dick Dougan on PHM and me on Jetfoil both reporting to Vern Salisbury. When I wasn't launching, transiting or testing boats I was training customer crews in Hong Kong and Hawaii.

My next Jetfoil adventure which I will never forget was the delivery of boat 006 to Venezuela.