BUILDING IT WAS HARD

SELLING IT TO THE PENTAGON WILL BE HARDER

BY CAROLINE WINTER

PHOTOGRAPHS BY GUIDO VITTI

"WE'D HAD ALL THESE EXPERTS TELLING US... IT'S GOING TO NOSEDIVE AND FLIP OVER. AND ALL OF THE SUDDEN, IT RUNS PERFECT. IT'S NOT UNSTABLE AT ALL"

On the northern edge of the Portsmouth Naval Shipyard in Maine, past the security checkpoint and high-tech stations for refurbishing nuclear submarines, is a derelict warehouse that once doubled as a sawmill. Building 129's corrugated metal exterior is rusted and overgrown with bursts of ivy. Broken glass in some of the windows has been replaced with clear plastic. Inside, it takes a moment to adjust to the cavernous silence and dim orange lighting, but one immediately senses the hulking presence of the hangar's inhabitant: a vessel called *Ghost*.

Matte gray, with the chiseled angles of a Nighthawk stealth aircraft, *Ghost* doesn't look like a boat. Its 38-foot main hull is designed to travel above the water's surface, propped up by two narrow struts, both 12 feet long and razor-sharp at the front so they can cut through ocean debris. Underwater, each strut is attached to a 62-foot-long tube that contains a gas turbine engine. Hinges allow the struts to move up and down like wings. While parked, or traveling through shallow waters, they can be extended to the side. In deeper waters, at speeds of eight knots or higher, they can rotate downward to lift the hull into the air, eliminating the jarring impact of waves.

Four propellers positioned at the front of the tubes are powered by the two 2,000-horsepower engines. They pull the craft and, with the help of air funneling down through the struts, create a gas bubble around each tube–an effect known as supercavitation that can reduce drag by a factor of 900. In short, *Ghost* makes a bubble and flies through it.

"It's such a smooth ride, you can sit there and drink your coffee going through six-foot swells," says Gregory Sancoff on a recent trip to the hangar. A self-made millionaire who started a string of medical technology companies, he's looking up at *Ghost*, grinning. This is his baby. Sancoff came up with its design, leased the ramshackle hangar, and built the vessel entirely on spec. His 18-person startup, Juliet Marine Systems, has invested $15 million in the project.

Ghost, Sancoff says, could be used as a kind of "attack helicopter of the sea"–conducting coastal defense and anti-terrorism missions and protecting massive naval vessels from swarm attacks by armed speedboats. Built from aluminum and stainless steel, the vessel is nonmagnetic and difficult to target using sonar. "We came up with the name *Ghost* because the boat is intended to have no radar signature at all," says Sancoff. "With *Ghost*, you can get into denied-access ocean areas and loiter for 30 days with the fuel on board. You can listen to cell phone conversations, you can monitor what's going on, you can launch operations and leave, and no one knows you're there." He adds, "That's not something the government can do right now."

Juliet Marine's board includes an impressive roster of what Sancoff calls "type A personalities." These include former New Hampshire Senator John Sununu Jr., recently retired four-star Admiral James Hogg, and retired Rear Admiral Jay Cohen, who served as Defense's chief of naval research and under secretary for science and technology at the Department of Homeland Security. Also on board is Rear Admiral Thomas Richards, a grandfatherly retired commander of special warfare who oversaw all of the country's Navy SEALs. "We expect to be breaking the speed record for SWATHs–Small Waterplane Area Twin Hulls–by the end of the season," says Richards. "The Navy has nothing like this."

With Juliet Marine nearly ready to launch speed tests and build additional, refined models, Sancoff hopes the Department of Defense will sign on and buy his boats for roughly $10 million apiece. Top government officials, including Admiral Michelle Howard, vice chief of naval operations, who led the 2009 *Maersk Alabama* hijacking rescue, have recently toured *Ghost* but declined to comment for this story.

Sancoff knows it won't be an easy sell, despite his venerable board members. "I think DOD is very, very nervous about working with small startup companies," he says. Especially when the technology is so unusual. Sancoff tells the story of a Navy SEAL who paid him a visit: "He said, 'Sir, look at that picture behind your desk of *Ghost*. That's not a boat. No one knows what you're doing. They don't get it.' "

At 57, Sancoff has a full head of gray-brown hair and a faint New England accent. On the day of the hangar visit, he's wearing blue loafers, jeans, and a short-sleeved white button-down patterned with tiny blue anchors. *Ghost* is Sancoff's first attempt to build a weapons platform, but he's never been shy about pursuing implausible ideas. "My whole philosophy in life has been this: I will only work on stuff where people will look at me and go, 'Are you crazy?' " he says. "When I was very young I just said to myself, I'm not going to work on something someone else can do–why waste my time? I'm going to work on the hardest problem."

After attending vocational-technical high school in Lawrence, Mass., Sancoff saved up money and skipped college to start a machine shop. Mainly, he devised and manufactured prototypes for various local companies, including microwave filters and syringe pumps. "Did I want to go to college? Kind of, but I also wanted to start a business immediately," says Sancoff. At 24, he sold the shop and left Lawrence for San Diego. "Steve Jobs was worth probably $50 million, and he was the same age as me. I thought, if he can do it, I can do it–I mean, come on!"

In California, Sancoff got a job as a technical consultant for the video game company Sega. He next honed in on the medical device industry, inventing products including a computerized IV pump and a tool that allows surgeons to suture without a needle. (Resembling a gun, it grabs tissue, forces a thin filament through a tiny hole, and ties off a knot in one motion.) Over the next 20 years, he built and sold five companies–Block Design, Block Medical, River Medical, Ivac Medical, and Onux Medical–for a total of more than $500 million. Kevin Kinsella, founder of the La Jolla (Calif.)-based venture capital firm Avalon Ventures, whose investments include Zynga, the Broadway show *Jersey Boys*, and several technology and life sciences startups, met Sancoff during those early days. "He's a guy that'll take a stack of engineering magazines to read in bed, that sort of thing," says Kinsella. "He's got this great polymath engineering mind."

After the death of his father, a decorated Army sergeant who served under General George Patton in World War II, Sancoff began contemplating ways to give back to his country. To him, that meant shifting his focus from medical devices to weaponry. In 2000, when suicide bombers in Yemen attacked the Navy's *USS Cole*, Sancoff recalls, "I said, 'Wait a minute: Some yahoo terrorists in a cheap little boat and $500 worth of explosives can kill 17 sailors on a billion-dollar ship?' " Not long afterward, he came across a 630-page U.S. Navy report on an exercise called Juliet, in which the Navy attacked a battle group with small, high-speed boats. By the end of the second day of simulated warfare, the U.S. had lost more than 20,000 servicemen. It seemed obvious that the Navy was in need of improved small craft.

As a teenager, Sancoff had spent several years helping a friend's father fashion components for hydroplanes, a type of high-speed racing boat that skims across the surface of the water. Building off that knowledge, Sancoff began reading up on marine technology. To make a stable vessel that doesn't shoot into the air, as surface-skimming hydroplanes are wont to do, the hull needed to be anchored to the water. But how can one move something through the water without creating debilitating drag? The answer: Supercavitation. Among other benefits, the phenomenon makes craft more fuel-efficient and more stable for shooting at targets. The Russian military, Sancoff learned, had built a supercavitating rocket-powered torpedo, which traveled at 200 knots, roughly four times as fast as American weapons. But the torpedo was difficult to steer. The problem, he realized, was that the propellers were pushing from the back, rather than pulling from the front. "If you push a pencil across a table, it's very hard to keep it going straight," Sancoff explains. "If you pull the pencil, it's easy."

Installing *Ghost*'s propellers in front solved not only the control problem but actually furthered the vessel's supercavitation by helping to push water aside, making room for air coming from above the water. It also meant that the craft would potentially be more stable and have less drag than hydrofoils, which also have hulls that rise out above the water. "That was the eureka," says Sancoff. "I immediately started designing the boat on my kitchen table with a pen and paper."

After founding Juliet Marine, named for the disastrous Navy exercise, in 2007, Sancoff filed for more than a dozen patents for his technology and began building a full-scale plywood mockup of *Ghost*'s hull. He set up Juliet Marine's headquarters in downtown Portsmouth, N.H., in a white three-story house from 1725, bordered by a white picket fence and garden beds filled with broken clamshells.

In the spring of 2009, Juliet Marine secured a rental agreement for the Naval base hangar. "It was full of junk when we got it–old wooden mockups of submarines and that sort of thing," says Sancoff, who had only four employees at that point. Investing $5 million of his own money, he built the first full-scale prototype in two years with the help of contractors.

GHOST IN HANGAR: COURTESY JULIET MARINE

From left to right: Sancoff emerging from the cockpit, The view from the craft's helm, *Ghost* in its Portsmouth hangar







A major challenge for *Ghost* is that the Navy's policy is to buy only technologies in which it has announced interest. "It is not procedure to procure a system without established requirements," says Commander Thurraya Kent, spokeswoman for the Navy's research, development, and acquisitions arm. In the fall of 2009 the Defense Advanced Research Projects Agency (Darpa) briefly expressed interest in funding the *Ghost* project, but Sancoff declined its request for a formal proposal because the agency required use rights to all of Juliet Marine's patents. "I'm a startup company–this is how I'll earn money, by owning the technology," says Sancoff. Darpa declined to comment.

Over the years, Sancoff sent the Office of Naval Research images of his design. "They laughed at me; they thought I was crazy," he says. "'Those jet engines can't run underwater in those tubes. That boat can never be stable. You can never supercavitate those hulls.' Obviously I was discouraged."

In October 2009, after about six months working in the hangar, Sancoff got a frantic call from his patent attorney. "He said, 'I got something in the mail, I've never seen anything like it, and I've been practicing for 35 years,'" remembers Sancoff. The letter, from the U.S. Patent and Trademark Office, with a recommendation from the Office of Naval Research, turned out to be a secrecy order, forbidding Juliet Marine from filing its patents internationally or talking with anyone, including potential investors, about its technology. "They didn't explain why.... They wouldn't talk with my lawyer. They wouldn't talk with me," says Sancoff.

For two summers, *Ghost*'s trial runs were conducted only at night. "We were going out at like 3 a.m.," says Joseph Curcio, a marine engineer who taught at the Massachusetts Institute of Technology and designed robotic systems for the Navy before joining Juliet Marine in 2010 as vice president of research and development. "We'd have to cover the [propellers] with a blanket and move the boat in the dark. We weren't allowed to let anyone take pictures."

The secrecy orders were lifted after two years, also without explanation. That's when Kinsella of Avalon Ventures heard about *Ghost* and joined the company's board, investing $10 million. "We've never done a military application before," he says, before pointing out that Sancoff has a strong track record as a serial entrepreneur. "I've always made money with this guy. He can squeeze a nickel until the buffalo pees."

Ghost failed to lift out of the water on its first dozen trial runs. Then, one day in 2011, with Sancoff and Curcio at the helm, *Ghost* emerged from the water. "We'd just gotten all the controls right," says Curcio. "We were calling over to the chase boat, asking 'Are we up? Are we up?' and Tom [Richards] radioed over, like, 'I can't believe it, I can see, like, four feet under the hull.'" Euphoria ensued. "We'd had all these experts telling us...it's going to nosedive and flip over," says Sancoff. "And all of the sudden, it runs perfect. It's not unstable at all."

Not long afterward, Sancoff accidentally drove the craft into the rocks. "The Admiral was away on a business trip, so we got to blame him," says Curcio. Admiral Richards generally captains the *Ghost*'s chase boat during trial runs. "We had no adult supervision," adds Sancoff. "I was not happy with myself, to say the least."

That's when Juliet Marine hired Cliff Byrd, a 6-foot-3 former Navy SEAL trained to drive anything from a dumptruck to a Mark V Special Operations Craft. Byrd, 36, had spent 12 years with the SEALs, traveling more than 220 days a year to hot spots around the world. Mild mannered, with a shaved head and an arm tattoo that reads Strength From Above, Byrd says he cannot talk about his missions but that he left the Navy to spend more time with his wife and two daughters after a helicopter was shot down in Afghanistan, killing some of his friends. Like so many of his colleagues, Byrd suffers from back pain and permanent injuries to his elbows, caused by the harsh impact of riding in small boats through rough seas.

"You'd think skydiving or all the other things we do, that you'd get injured from that, but actually it's the boats that you take most of the beating on," he says. "A lot of guys have back injuries, hips, ankles, knees, shoulders, you name it–any joint, just because of all the shock your body goes through."

The smoothness of *Ghost*'s ride is perhaps the team's greatest point of pride. "I was riding down to Newport, and we had up to 8- to 10-foot seas," says Byrd. "We're sitting in here joking about it and not actually feeling anything." Sancoff slept for half the ride. "But the chase boat that came along with us pounded through the ocean so bad," he says. "They were seasick, throwing up. When we got to Rhode Island, I said, 'Let's go and get a steak,' right? They couldn't even eat."

Roger Schaffer, a member of the Society of Naval Architects and Marine Engineers, worked as a civilian contractor on Navy ship design for 42 years. He saw Juliet Marine give a presentation about *Ghost* earlier this year. "It's difficult to come up with something new in a field like naval architecture, but they've managed to combine a number of features into an overall concept that looks quite attractive," says Schaffer. "If the supercavitation technology of the *Ghost* proves successful, it will allow the *Ghost* to obtain significantly higher speed than hydrofoils or SWATHs have been able to achieve." That said, Juliet Marine faces a tough battle. "Normally, innovative ship designs stem from funded research by the Navy at one of their labs," says Schaffer. "[Juliet Marine] also has a problem with the institutional bias the Navy tends to have against small crafts like the *Ghost*."

In the face of budget cuts, Defense officials have asked companies to fund more of their own research, which is why Juliet Marine personnel are surprised they haven't garnered more interest. Juliet Marine hopes things will change if the craft breaks the commercial SWATH speed record of 31 knots. So far, *Ghost*'s top speed is 29 knots, but Curcio says 50 knots is within reach, roughly the speed of Mark V boats, a formerly popular mode of transport for Navy SEALs that was discontinued in 2012.

Seven U.S. allies, including Qatar, Israel, and Korea, have expressed interest in *Ghost*, according to Sancoff. "A lot of countries adopt new technology much more rapidly than the U.S.," he says. "Do I want to see this boat in the Persian Gulf with another flag on the back of it? Not necessarily. But if that's what it takes to make this company successful, to supply boats to the U.S. Navy, then we'll do it," he says. The Wright Brothers, he adds, got a contract from France before the U.S. government. "They thought they were crazy, too," says Sancoff. "It took years for the Wright brothers to convince [the government] that an airplane might be viable."

The potential market for new naval vessels will reach about $46 billion in the next nine years, according to AMI International, a global defense market analysis firm. Juliet Marine says *Ghost*'s technology could also be adapted to build stable, superfast torpedoes or unmanned sea drones. Commercial possibilities include jet skis or craft for transporting workers to oil platforms. "These rich bankers who take helicopters from [Wall Street] to the Hamptons now, you know?" adds Kinsella. "If they don't want to take a helicopter, the *Ghost* could take a bunch of people out there at high speed." Juliet Marine is in talks with Barclays about an initial public offering, and Kinsella says the startup isn't opposed to an acquisition by a larger defense contractor. The startup plans to build two additional boats by the end of the year, which will be used for weapons testing and demonstrations.

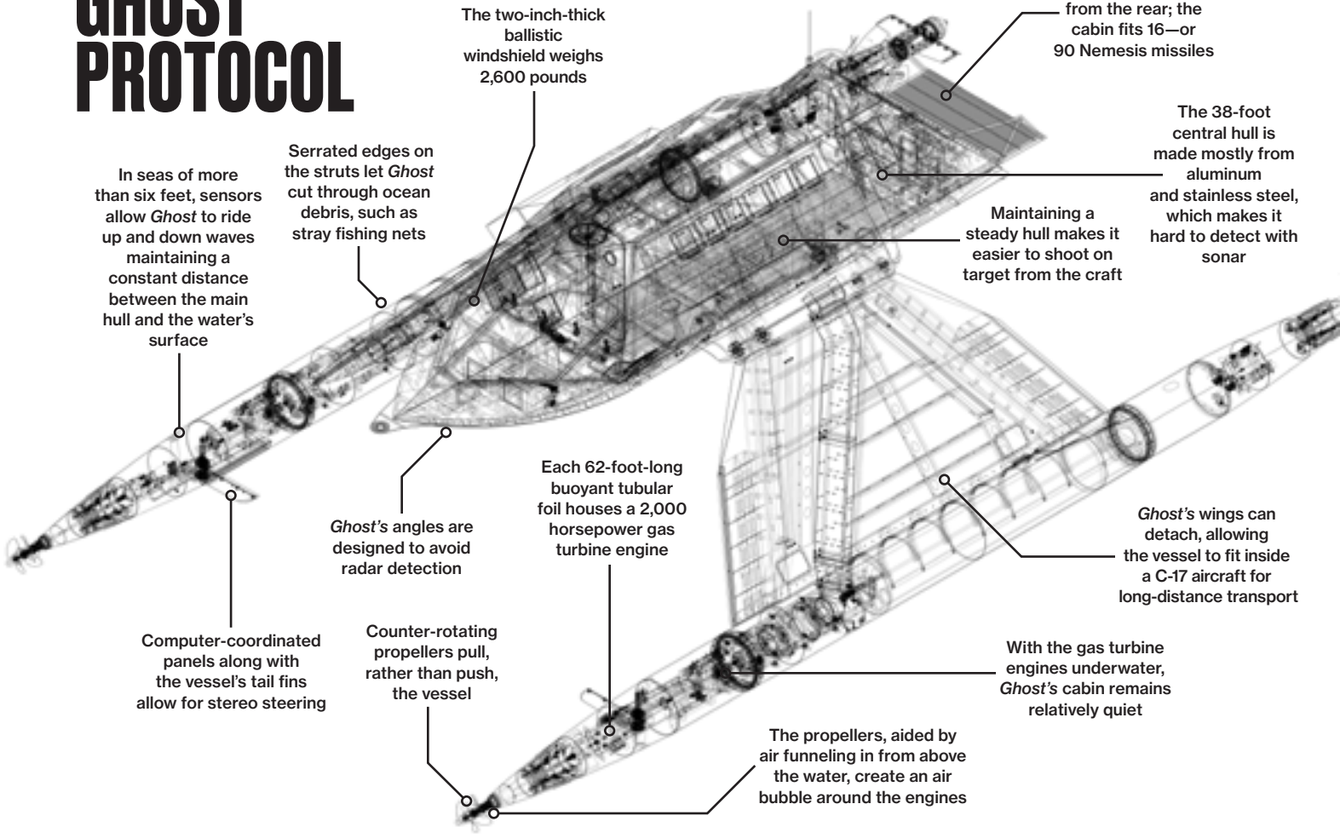
With its patents now available to the public, Juliet Marine's staff worries other countries and companies will steal its technology. "The Chinese are probably already starting to knock this off," says Sancoff, adding that hackers attempt to break into his company's computer systems hundreds of times each month. One day in 2009, he arrived at Building 129 to find the locks broken. He assumes whoever did it wanted to photograph the boat's parts; the break-in remains unsolved, he says.

On a sunny morning in July, *Ghost* is tethered to a buoy off the Portsmouth shipyard in the Piscataqua River. Curcio and Byrd climb aboard through the back door, above which is emblazoned New Hampshire's motto: Live Free or Die. They'll be manning the ship for a trip down the river out into three-foot swells in the open ocean.

Up front, the cockpit is outfitted with large windshields fashioned from two-inch-thick glass. There are multiple screens displaying maps and *Ghost*'s various controls, but Byrd needs only the throttle and a four-inch joystick to steer the craft. As he turns on the engines and ventilation, the vessel sounds like an airplane lifting off. The back cabin, big enough to transport 16 people, is dimly lit. Seats clamped into the metal grid floor are outfitted with quick-release race car safety belts. There are no windows but for two round glass panes near the cabin floor, each with a diameter of about six inches. Through them, one sees the water gushing by–until the hull lifts up into the air. Then, against a blue backdrop of the ocean below, one sees only drops of spray against the portholes. B

For a video on Ghost, *go to*: www.businessweek.com/ghost-boat

GHOST PROTOCOL



COURTESY JULIET MARINE

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