

City Talk



Stockton Rush, one of the five who died, at the helm of the Titan. Rush was head of OceanGate Expeditions, which owned Titan.



TITAN WAS CURSED FROM THE GET-GO

The Titan, a deep-sea exploration vessel used at the north Atlantic site of the sunken Titanic, suffered a tragic implosion, killing all five occupants.

The incident shocked the world, not just over the tragic nature of the deaths but also because the sub failed so early in its mission.

A full investigation will take time, but there are many telltale signs that showed the incident could have been avoided.

The Titan was a carbon fiber cylinder with two end domes.

The 6.7-meter-long carbon fiber shell was supposed to be robustly constructed, with a thickness of about 13 millimeters. It weighed some 10,000 kilograms.

The end domes were made out of titanium alloy, a material whose use is proven in deep sea vessels. The front one had a 380-mm diameter acrylic window to allow occupants to have a clear vision.

As deep-sea vessels do not have their own motive power, Titan was mounted on a platform to which auxiliary equipment was attached, including propellers, and ballast weights and balloons to control the lowering and raising of the vessel.

All these are controlled by a modified Logitech wireless game controller, not uncommon with such unmanned vessels.

Safety features included life support for five for 96 hours and text messages to be sent to the support ship.

Ballast weights, attached to the platform, can be dropped, together with balloon shaped devices that can be inflated to provide buoyancy for resurfacing.

A backup system of sandbags held by hooks with attachment assembly, with the materials soluble in seawater after immersion for a number of hours, would have allowed the vessel to resurface even in the event of total loss of control.

The vessel was not designed to carry passengers from a port, so it was not subject to safety regulations. There was no requirement for seaworthy certifications.

Hence passenger safety was totally in the hands of the exploration company.



Nuts and bolts

Edmund Leung

When Titan lost communication after less than two hours, a frantic search was organized, taking in the best deep-sea vessels in north America and Europe.

These unmanned remote control vessels are capable of reaching that depth and have mechanical arms to retrieve debris.

After about three days, they found flattened pieces of the carbon fiber cylinder, supporting the implosion theory, and retrieved the two titanium end domes.

These were still intact but as the slings of the front cone was seen passing through the cavity where the acrylic window would have been, it confirmed that the window had been dislodged.

All of these supported the theory that the vessel had imploded upon descent, long before the three hours needed to reach the 3,800-meter depth.

Experts guessed that the cylinder failed under high water pressure. This could possibly be from propagation of small cracks in the shell from past explorations, or a bonding failure between the cylinder and the titanium cones.

Experienced engineers know it is not practical to inspect carbon fiber shells for tiny cracks and that secure bonding between carbon fiber and titanium for high pressure uses is not easily achieved.

They also know that carbon fiber, when fabricated into a cylinder, may be effective at withstanding internal pressure but not external pressure where the fibers cannot resist the pressure forces since they are not under tension.

This incident serves to remind engineers to be extra careful in designing machinery not proven to operate in extreme conditions. The public must also assess the possible consequences when using unproven systems.

Veteran engineer Edmund Leung Kwong-ho casts an expert eye over features of modern life