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Abstract

This article will give an overview to the development, manufacturing process and certification of the manned submersible ICTINEU 3, a work class vehicle with high capabilities for research, ocean observation and underwater intervention, but also suitable for filming and leisure. It has been designed for 1.200 meters depth and a crew of three: one pilot and two observers (passengers) with certification and classification by Germanischer Lloyd. The challenge was to achieve a very small and lightweight but at the same time versatile and highly operational vehicle, with the aim to improve the capabilities of existing submersibles in this depth rate. The result is a new generation of manned submersible, a compact vehicle of only 5300 kg, with no need for syntactic foam, that can be easily operated from most research vessels and incorporates outstanding innovations such as a lithium-ion-polymer battery system that will provide the vehicle with a high power capacity.

Keywords – Manned Submersible, Research Platform, Ocean observation and intervention

I. INTRODUCTION

Ictineu Submarins SL was founded in 2007 to develop and built the ICTINEU 3: a scientific manned submersible, a work class vehicle with high capabilities for work, observation and intervention, also suitable for filming and leisure. It has been designed for 1.200 meters depth, and a crew of three: one pilot and two observers (passengers). It will be certified and classified by Germanischer Lloyd. The challenge was to achieve a very versatile and highly operational vehicle, with the aim to improve the capabilities of existing submersibles in this depth rate. Cutting-edge technology has been used in the design and construction and several innovations have been introduced. These include: innovations in stainless-steel materials and design for an unparalleled volume to weight ratio of the pressure hull; composites (CFRP) have been largely used as structural and constructive material; it will incorporate the first certified, pressure-tolerant lithium-ion-polymer battery system for high energy capacity; and it includes improvements in the design and ergonomics of work-class submersibles (better performance, safety and comfort).

The result is a small and very lightweight vehicle (less than 5300 kg) that can be easily operated from most research vessels; passengers can enter/exit from the

surface of the water; it has a high power capacity (10 hours full autonomy at normal load capacity), and it is expected to be able to travel up to 20 nautical miles underwater; power and communications system has been dimensioned so they can adapt to any task and mission requirements with capability to upload any instrument or sensor from the client in an easy and quick way; propulsion and manoeuvring are based on a complete 6 controllable degrees of freedom system, with a configuration of 8 thrusters, 2,5kW each with proportional control, and internal buoyancy tanks. A wide field of view is provided by a large (1,5m diam.) acrylic dome.

III. SUMMARY

The design of ICTINEU 3 submersible started in 2004, engineering and pressure hull calculations started in 2008 and main construction works in 2009. Eight years later the vehicle is about to be finished. All engineering has been finished, as well as the construction of pressure hull, exostructure and subsystems. All equipment is ready for final assembly and testing. Final certification, sea trials and classification are expected for spring 2013. One of the main steps in the construction of a submersible is the pressure test of the pressure hull, that for ICTINEU 3 was successfully completed in summer 2011.

Once the vehicle is finished, the company itself will operate the submersible and offer diving services. Operation of ICTINEU 3 submersible can be adapted to any need of the client, either for long campaigns on a mother ship or on a daily basis with the need of only a small surface support vessel. A daily mission of 8 hours can be run, and a time lapse of 5 hours is needed to re-charge the batteries. As the implementation of instrumentation and sensors can be done easily it can be used as a test platform for new equipment and applications.

The ICTINEU 3 team is eager and open to proposals for cooperation to the improvement of the oceans knowledge. New models are being explored to fund research and exploration projects.

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Fig. 1. ICTINEU 3 research submersible.

General Specifications

Max. Operating depth	1200 m
Weight in air	5300 kg
Length	4800 mm
Beam	1950 mm
Height	3000 mm
Hatch diameter	540 mm
Main (front) acrylic window diam.	1200 mm
Hatch acrylic window diameter	540 mm
Crew	1
Passengers	2
Payload	300 kg
Classification authority	Germanischer Lloyd

Life Support

Daily life support	24 hours for 3 people
Emergency life support	+ 96 hours for 3 people
Atmospheric control by 2 digital O ₂ and CO ₂ analysers	

Buoyancy and trimming

Diving tanks	600 L
Buoyancy tanks	240 L
Trimming	+/- 3 deg

Safety devices

Emergency drop weigh	500 Kg
Diving tanks	600 L
Emergency buoy	1800 m long rope
Total buoyancy generation of	800 Kg at max. Depth

Propulsion

Stern thrusters	4 x 2,5kW, 43Kg
Manoeuvring thrusters	4 x 2,5kW, 43Kg

Batteries

Main group 150V, 42kWh	Lithium-ion-polymer
Service and Emergency group	24V, 1,3kWh
Working autonomy	10h
Emergency autonomy	5 days

Dynamic Characteristics

Maximum surface speed	2,5 Knots
Maximum submerged speed	4,2 Knots
Cruising submerged speed	1,5 Knots
Autonomy range at cruising speed: 20 nautical miles	

Equipment

Underwater telephone
 VHF for Surface communication
 Flux-gate compass
 GPS
 Sonar
 Altimeter
 Depth control by two analogue depth gauges and one digital pressure sensor
 Doppler Velocity Log
 8 LED Lights of 6,000 Lumen each
 6- function hydraulic manipulators
 Basket for sampling
 CTD multi-parametric probe with pH sensor, ORP (Redox) sensor, Dissolved Oxygen sensor, Fluorometer.