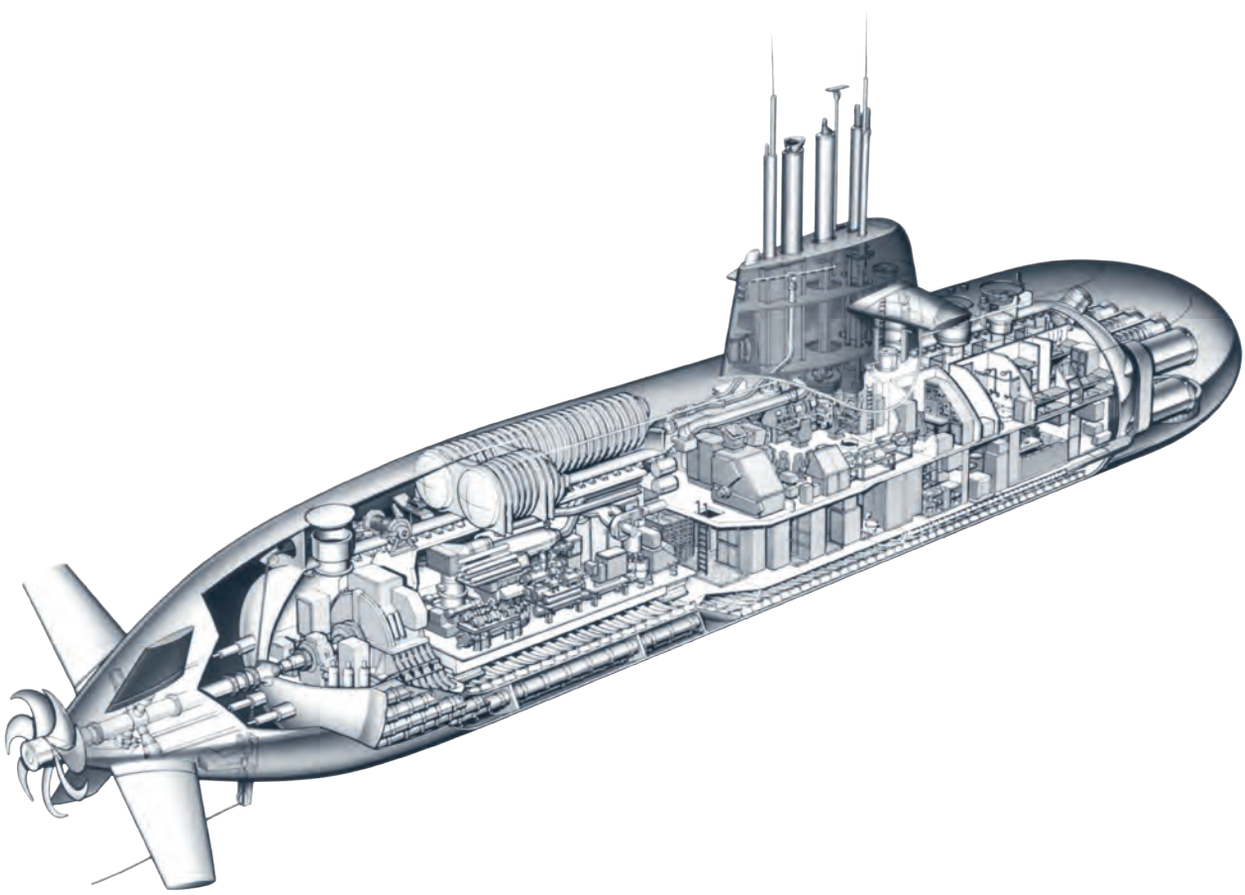
ARIANEGROUP

RESUS

RESCUE SYSTEMS FOR SUBMARINES

EMERGENCY SITUATIONS



RESUS provides a strong counter measure to all kinds of submarine emergency situations which are especially dangerous when the craft is submerged. Scenarios for RESUS are for example:

- outbreak of fire on board
- failure or unresponsiveness of the on-board manoeuvring system
- uncontrolled dive of the boat due to the jamming of the hydro planes in a diving position on account of hydraulics systems failure or the effect of depth charges
- water ingress into the pressure hull.

In these and other emergency situations which make it necessary to surface the submarine as quickly as possible RESUS is designed to empty the main ballast tanks (MBTs) of the submarine in all diving depths within a very short time (13-20 sec.), working independently from other on-board systems, including the on-board power supply.

A number of gas generators, which is automatically adapted to the actual diving depth, blow their gas load into the upper regions of the MBTs thereby replacing the ballast water and creating buoyancy, which lifts the boat to the water surface.

The system is protected against accidental actuation or external influence, e.g. shock waves due to underwater explosions, electromagnetic waves or inadvertent operation by the crew and can be run in preset manual or automated („dead man“) modes.

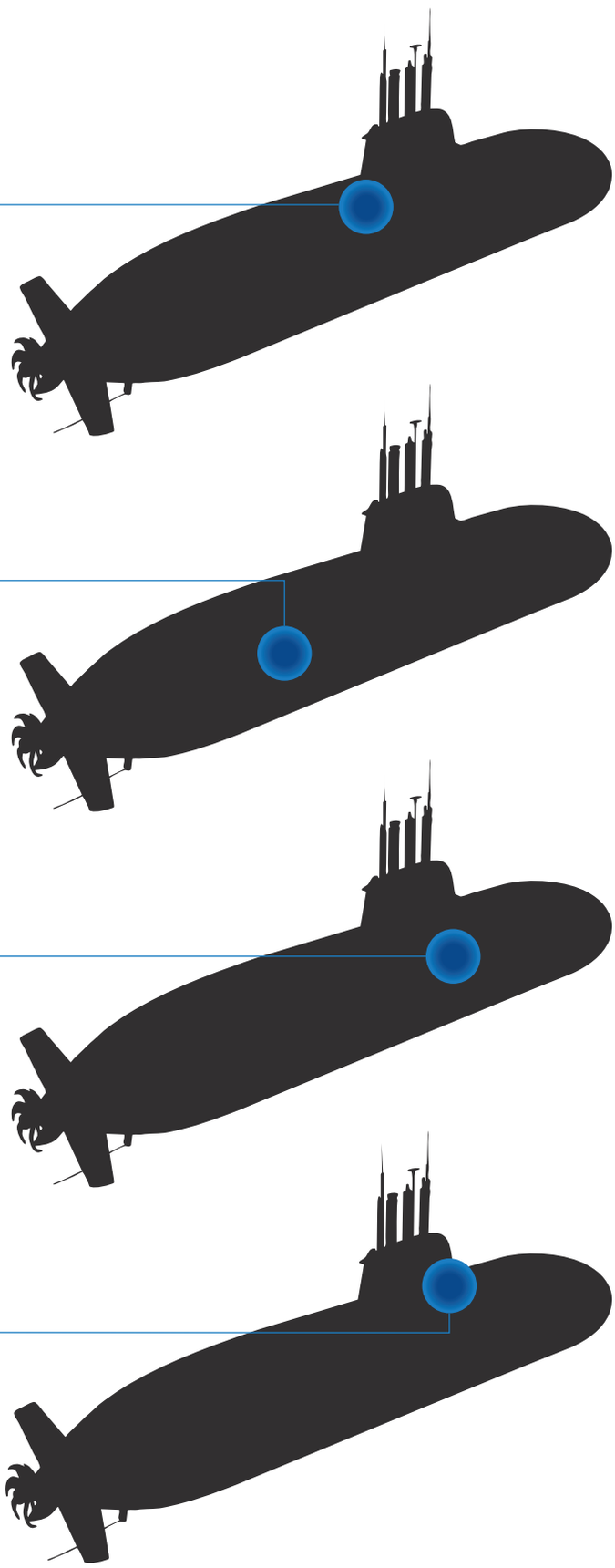
In case of outbreak of fire on board, failure of the on-board manoeuvring system and a lot of other cases, RESUS helps to survive.

FIRE

FAILURE OF PROPULSION SYSTEM

WATER PENETRATION INTO COMPARTMENTS

JAMMING OF HYDRO PLANES



SYSTEM COMPONENTS

GAS GENERATORS

Taking into account a **10-years maintenance-free storage time in the MBTs** and in order to assure safe handling of the propellant, a so-called „pre-packaged" design (premanufactured, fully operational) has been selected for the gas generators which are hermetically sealed. The generators are made of seawater resistant materials and will be charged by the manufacturer and delivered in an operational condition.

REMOTE STARTING DEVICE (RSD)

By means of the RSD, it is possible to initiate the operation of the gas generators inside the ballast tanks from various stations. Every submarine is equipped with two RSDs. The remote starting devices are sealed and shall only be used in an emergency case.

CABLE DISTRIBUTOR (CD)

The cable distributor is located in the main ballast tank. It is the connecting point for the gas generators from outboard via the pressure hull feed through to the CTU inboard. The number of connections depends on the numberof gas generators.

DIVING DEPTH MEASURING DEVICE (DDMD)

The task of the DDMD is to release the blockage existing below 1 bar water pressure and - after triggering the rescue system - to release a certain number of gas generators of the forward MBTs for operation by the start switch, according to the prevailing diving depth, or to start automatic operation at the critical depth (dead-man mode).

CONTROL AND TEST UNIT (CTU)

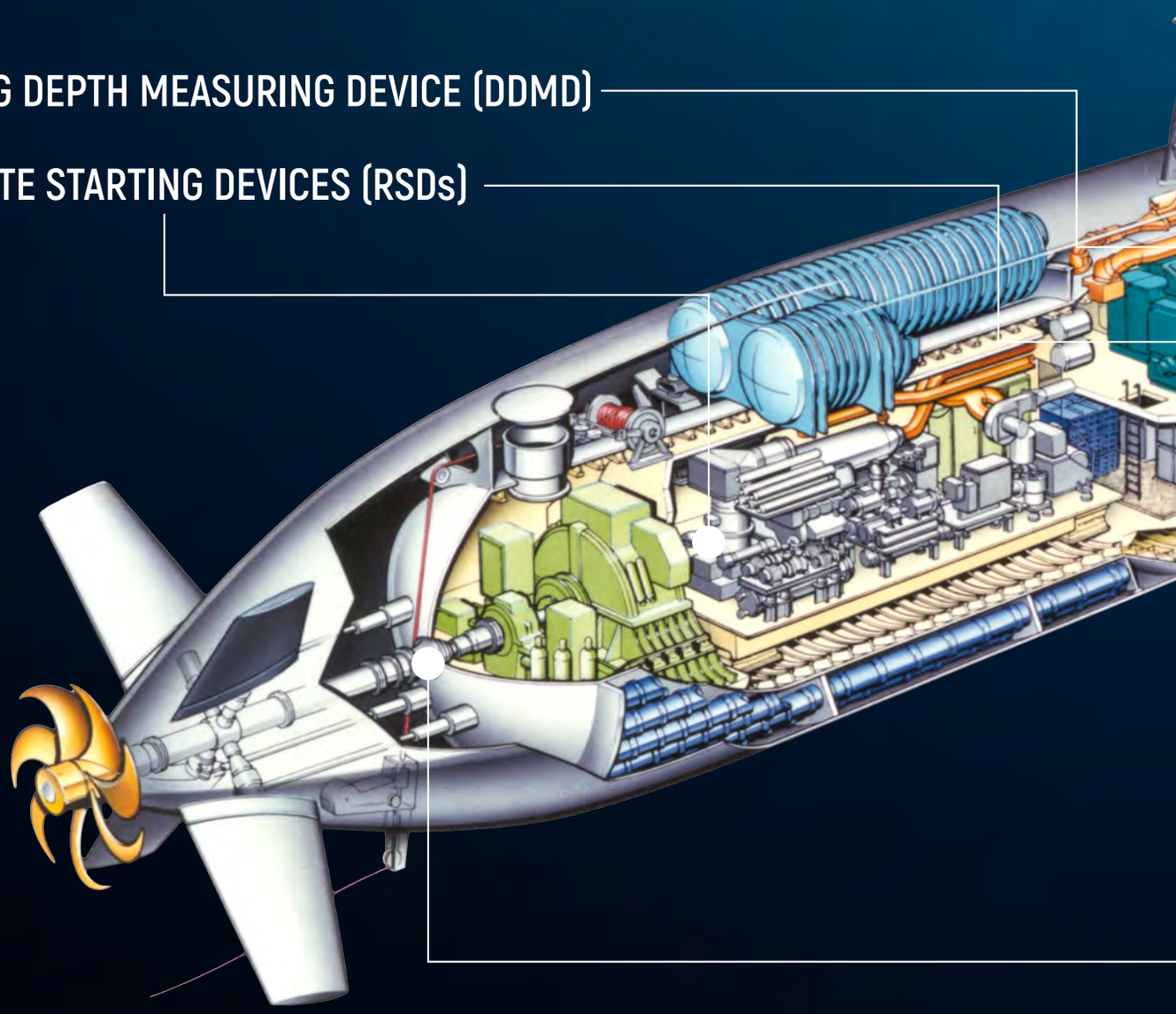
The rescue system is initiated by means of the CTU. This unit contains equipment to verify if the electric circuits are intact.
The CTU is encased in a stainless steel housing. All components are arranged in a slide-in unit, which can be removed for maintenance work. The major part of the electric elements is placed on exchangeable PCBs.

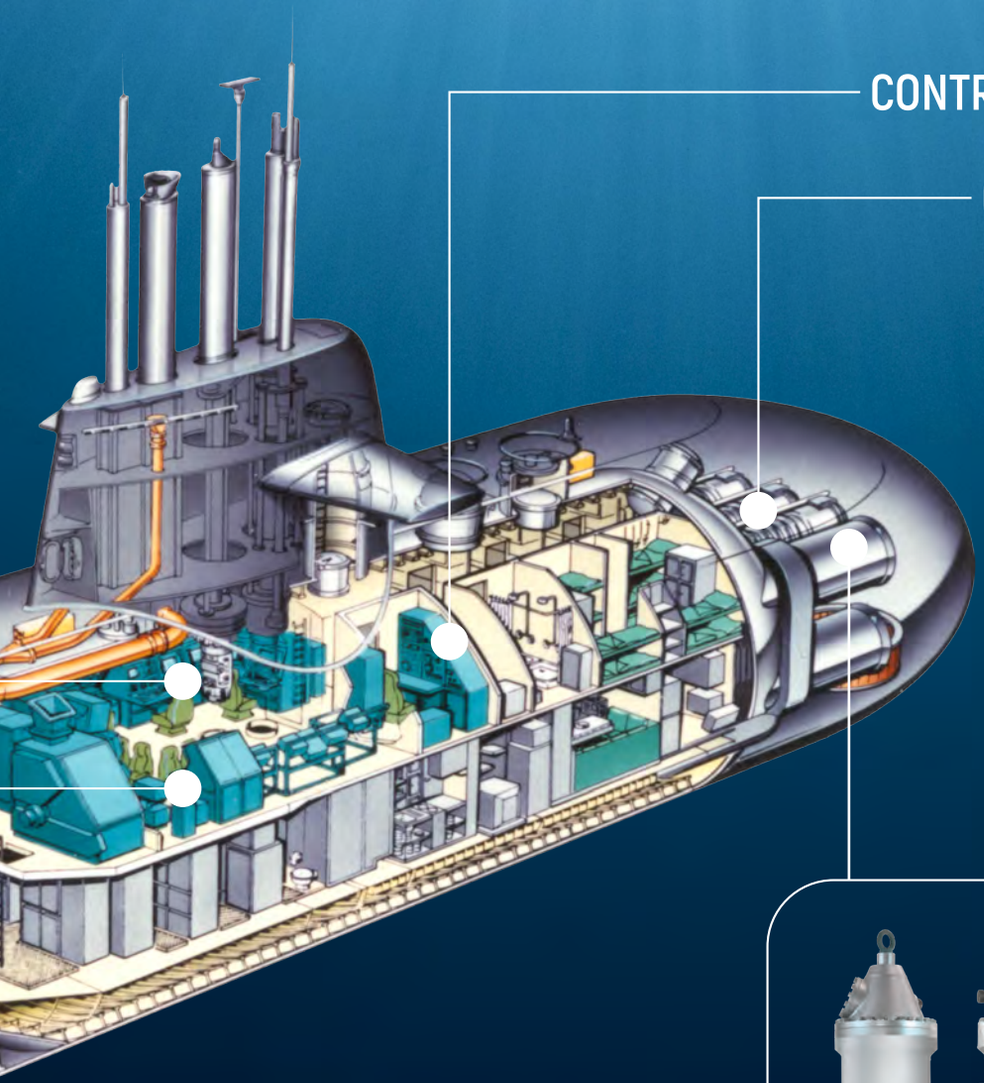
GENERATOR TOGGLE UNIT (GTU)

During installation and maintenance the GTU is inserted into the CTU housing. It switches the state of the Gas Genarators between SAFE and ARMED.

POSITIONS OF COMPONENTS

The illustration shows the location of the RESUS components in the submarine. Gas Generators and Cable Distributors are located in the aft and bow ballast tanks, the other components are located inside the pressure hull.





CONTROL AND TEST UNIT (CTU)

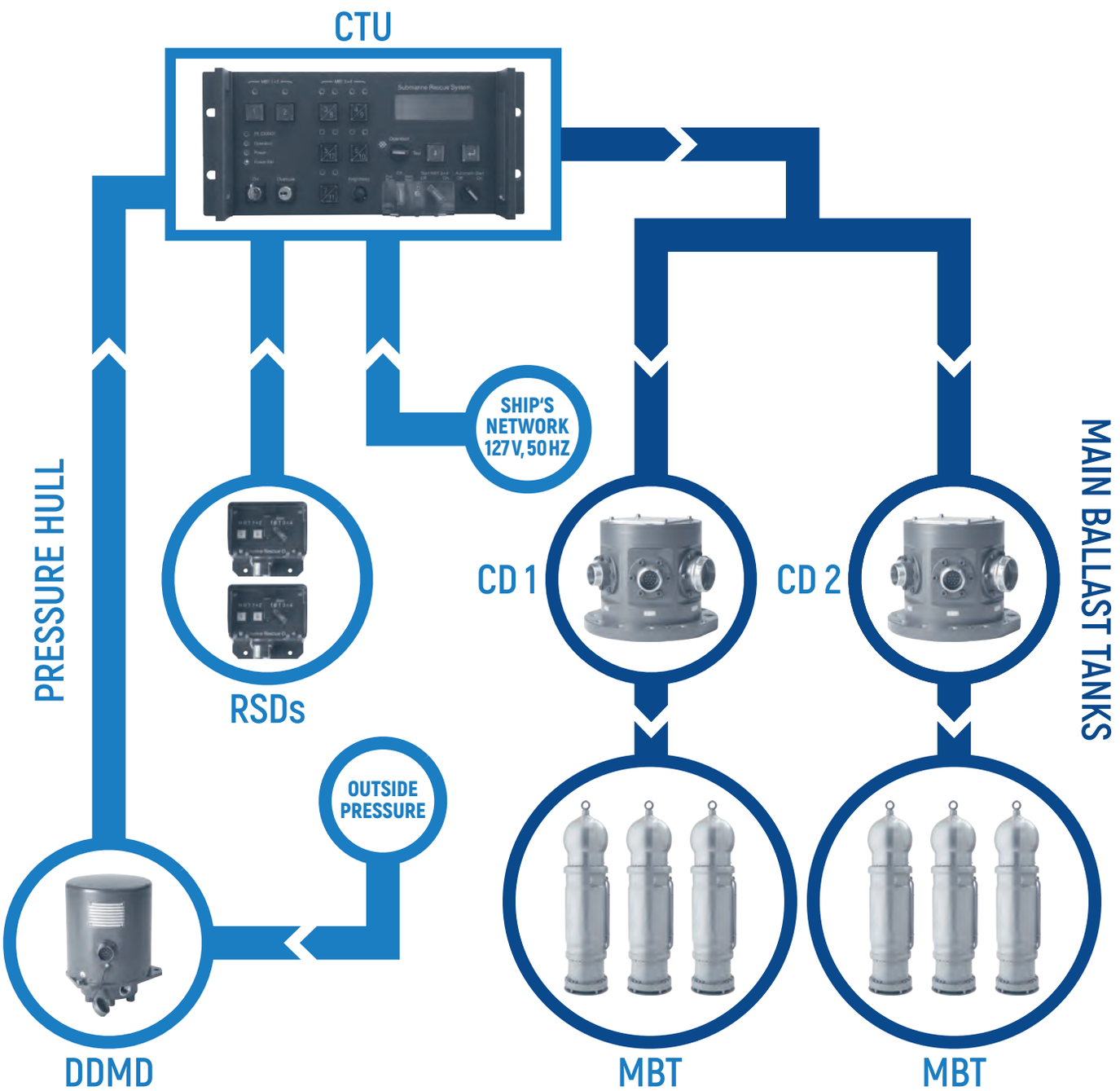
CABLE DISTRIBUTOR (CD)

The RESUS customer decides initially to install either the solid or the liquid types of gas generators, unique for the entire boat.

GENERATOR SOLID VERSION

GENERATOR LIQUID VERSION

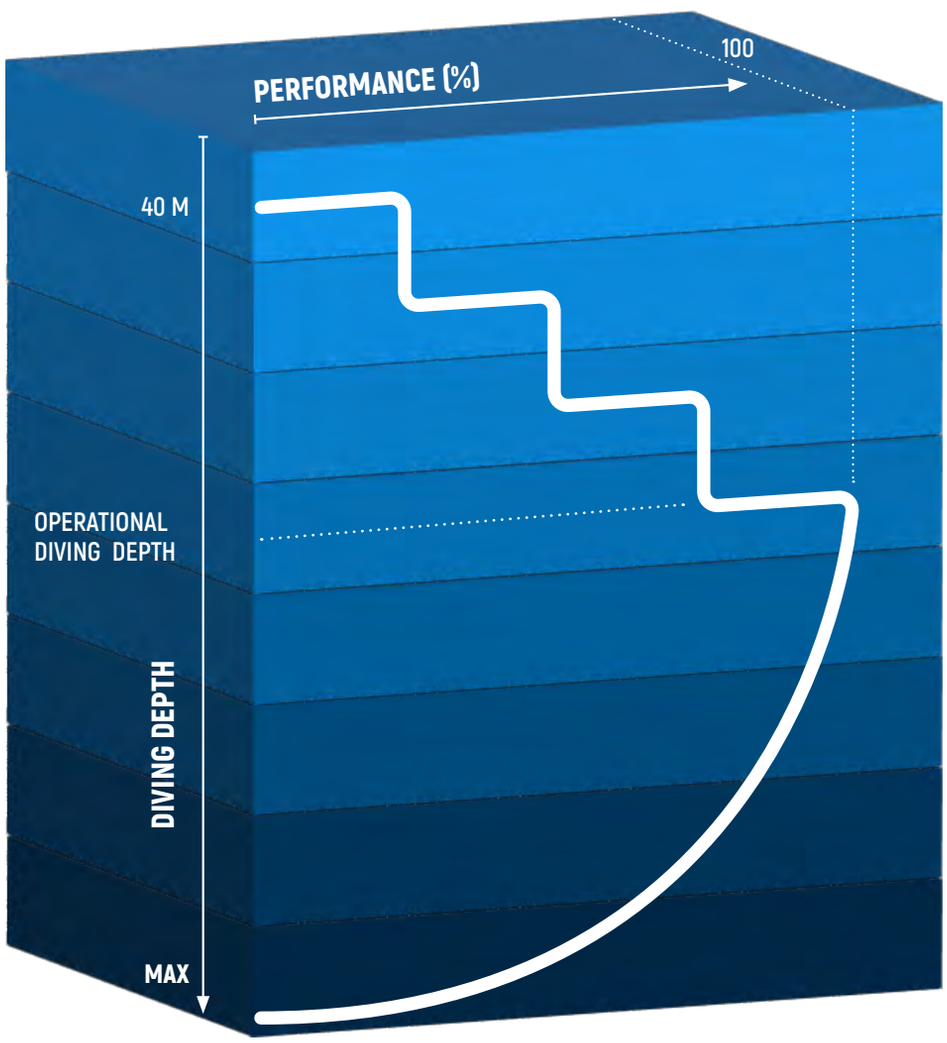
ELECTRICAL SYSTEM INSTALLATION



The Control and Test Unit (CTU) as well as the Remote Starting Devices (RSDs) and the Diving Depth Measuring Device (DDMD) are located in the pressure hull of the submarine whereas the Cable Distrubutors (CD) and the Gas Generators are located in the main ballast tank (MBT).

The gas generators are actuated from the CTU by an electric pulse via cable connection. Once the gas generators have been actuated, it is impossible to interrupt the process. Depending on the diving depth, the DDMD provides automatic selection of the number of gas generators to be actuated. The CTU storage battery is continuously recharged from the submarine's power supply sytem. In case of recharging failure, it is designed to run 100 hours even without recharging.

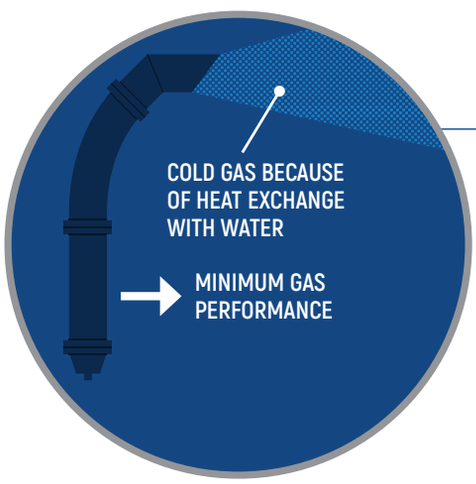
PERFORMANCE FOR ALL DIVING DEPTHS



The RESUS system empties the forward MBTs in a very short time. Each generator produces gas at a nearly constant rate for about 13 seconds. Automatic step-by-step actuation of individual gas generators prevents overloading of the MBTs during the start phase. System performance has been successfully tested on board of different submarines.

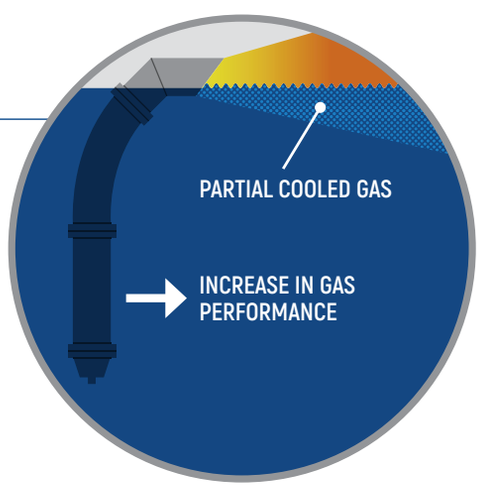
The Resus system is configured to empty up to 100% of the main ballast tanks in an operational water depth defined by the customer Navy. Beyond this depth, still a partial performance of the Resus system is available.

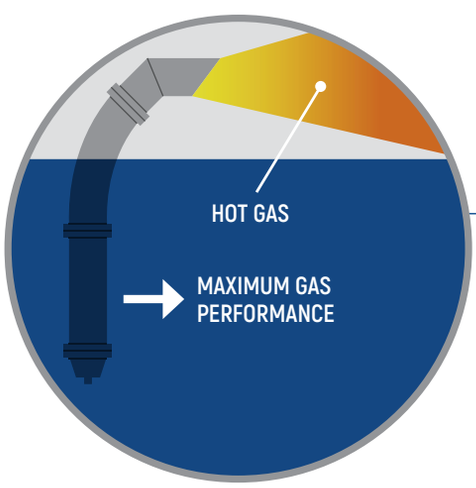
SYSTEM PERFORMANCE



The hot gas provided by the RESUS system interferes with the cold water in the main ballast tank. The provided performance is reduced by thermic effects.

A beginning gas bubble at the top of the main ballast tank increases already the provided gas performance. The jet deflector is installed in the upper section of the main ballast tank, to increase the performance.





A steady gas bubble at the top of the main ballast tank allows the maximum gas performance de-ballasting the maximum water volume.

CUSTOMERS OF RESUS SYSTEMS

REFERENCES

RESUS is standard equipment onboard all German submarines for more than 40 years. RESUS has been installed on many export submarines, on boat classes 206, 209, 212A, 214. In case of submarines with different geometries of ballast tanks, RESUS can be adapted to serve for these types of submarines.

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Pictures and drawings of submarines
have been provided by Thyssenkrupp