Multi-technology battery systems

Integrated solutions for torpedo propulsion

SAFT

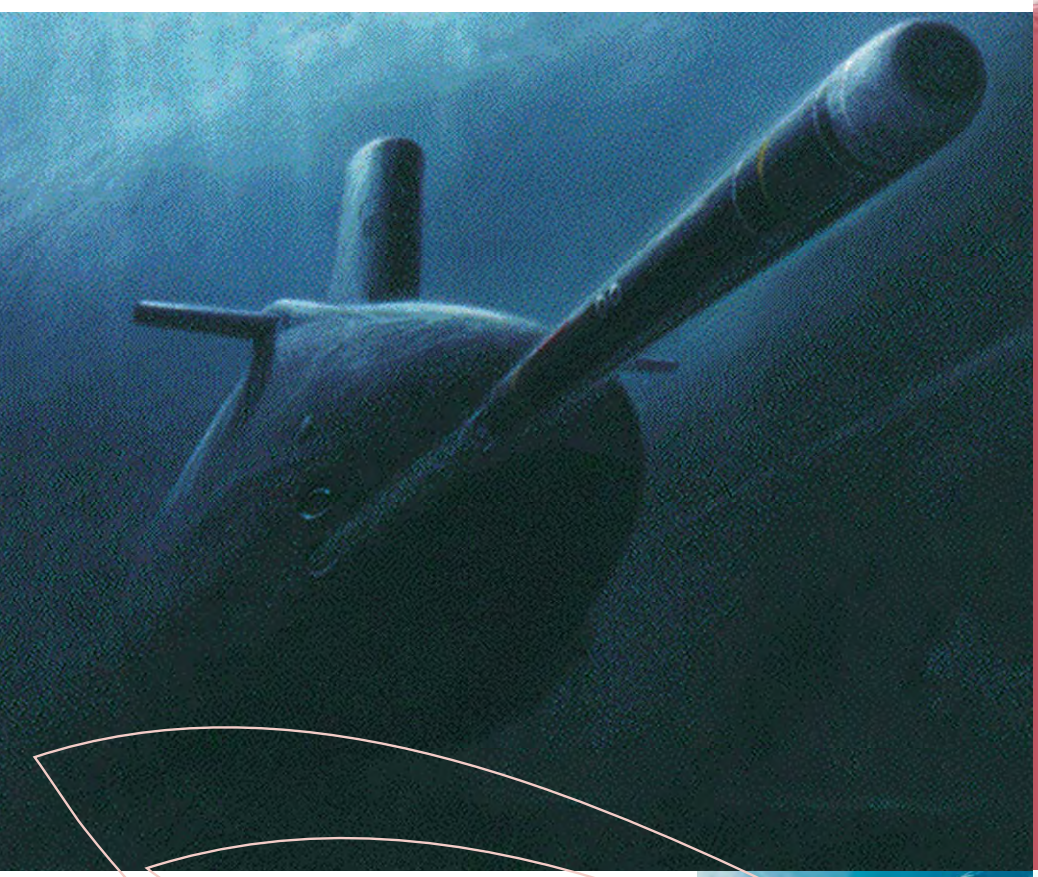
October 2006

Saft batteries for torpedoes

Meeting the challenge in defence

Saft is a global, multi-technology battery specialist and is the world's leading manufacturer of high-end batteries for industrial, transportation, space and defence applications.

The company operates at the forefront of innovation, developing and delivering advanced solutions for critical applications that are highly dependent upon integrated technology. As the next generation of intelligent defence systems takes shape, Saft is actively engaged in supporting major international companies leading this change.

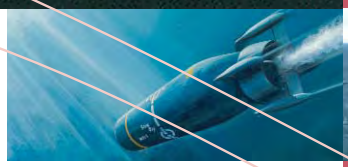


Worldwide, world-class capability

Saft's global reach and vast capability is already able to provide the fast, efficient and professional response necessary for large-scale production. Around 30 navies use Saft batteries to power lightweight and heavyweight torpedoes in training programs and combat roles.

Saft: total reliability

Saft's modern production facility at Poitiers manufactures standard and advanced solutions on sophisticated production lines employing a large variety of electro chemistries. Saft is qualified as a reliable supplier for all western electrically powered torpedoes.



– providing solutions through technology

A whole range of solutions…

Saft's extended range of technologies and track-record of reliability enable rapid and targeted response to customers' requirements. Saft will continue to provide exceptionally reliable solutions and is committed to maintaining the highest international standards.

…to meet any requirement

Saft is present throughout key defence markets and, having earned international recognition, is able to respond to any demand for electric torpedo batteries – for use in training and for deployment in action – in any technology.

Continuous improvement

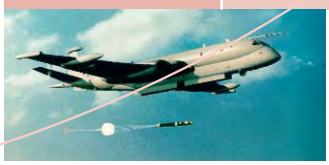
Saft has invested extensively for over 30 years in advanced production methods, research and product development. Maximised safety in storage and extended shelf life to over 8 years is now achieved – even in diverse environmental conditions.

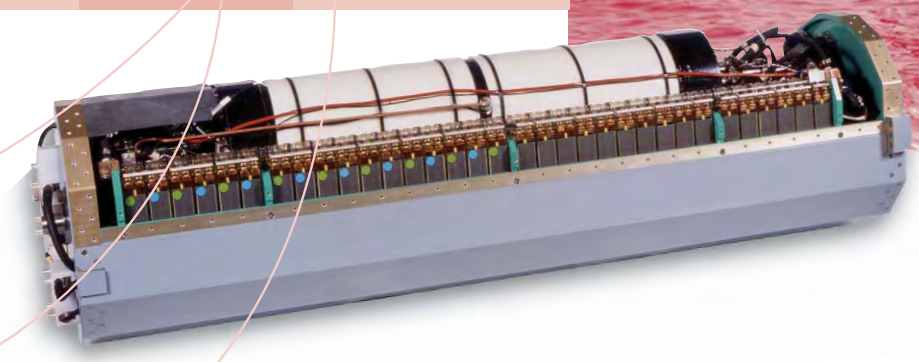
Saft torpedo battery technologies

Torpedo type	Size	Torpedo purpose	Technology
MK 44	LWT	Combat	Seawater-activated
A244 A244 Mod 3	LWT	Combat	Seawater-activated
Sting Ray	LWT	Combat	Seawater-activated
SST4 & SUT	HWT	Combat and Exercise	Silver-Zinc
DM2A3	HWT	Combat and Exercise	Silver-Zinc
MK 37	HWT	Combat and Exercise	Silver-Zinc
A184	HWT	Combat and Exercise	Silver-Zinc
Blackshark	HWT	Combat	Silver-oxide aluminium
		Exercise	Silver-Zinc
MU90	LWT	Combat	Silver-oxide aluminium

Example

Saft's Type PB47 battery for SUT/SST4 easily surpasses the specified 8 years shelf life with a typical 10 + 6 years period. A lifetime extension up to sixteen years is possible with this new generation of battery, markedly reducing the life cycle cost.





Absolute capability

Multiple technologies

Seawater-activated

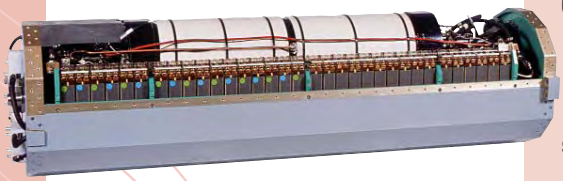
Operating principle The battery is stored without electrolyte, and activated by seawater after the torpedo has been launched. Through a scoop located in the hull of the torpedo, a continuous flow of electrolyte removes the heat, gas and mineral mud produced by the discharge and corrosion reactions.

Seawater-activated Type V616 and MK61batteries are used respectively for A244 and MK44 torpedoes. Saft is a sole qualified supplier of the V616 battery for A244 torpedoes.

Storage conditions:

- specified storage life 5 years
- actual storage life exceeds 10 years when the batteries are stored in their storage containers and protected against humidity

Silver-Zinc



Operating principle The battery is activated by a pyrotechnic device, ignited by an external electrical signal. Pushed by compressing-nitrogen, the electrolyte fills the cells through a distribution system. The battery is then primed. Heating of the electrolyte is possible.

Autonomy: from 13 min (high speed) up to 53 min (low speed)

Flagship products: batteries for DM2A1, DM2A3, DM2A4 & PB47 for SST4, SUT and A184 torpedoes.

Concept based on the assembly of multiple prismatic cells connected in series with the electrolyte stored in a separate reservoir.

The energy to transfer the electrolyte from its reservoir into the cells is provided by a pressurized gas tank.

Silver-oxide aluminium

Operating principle The electrolyte forms when sodium hydroxide powder is dissolved in seawater. Electrolyte circulates through the stack in a closed loop.

Silver-oxide positive electrode, aluminium alloy negative electrode and volta pile stack technology was developed in the 1970s in the US and then in France by DCN and Saft.

High temperature operation (>80°C) and high electrolyte conductivity provide for very good power capability.

Flagship products: AgO-Al stacks for MU90 and Blackshark.

Only aluminium/silver-oxide truly can provide twice the power and energy of the standard zinc/silver-oxide reaction within the same volume and weight allocation.

– specialised solutions deployed worldwide

Lithium-ion

Lithium-ion represents the most promising technology for exercise torpedoes. Specific batteries will be developed by Saft according to customer's specific requirements.

Li-ion cells can be connected in parallel without any specific devices. The torpedo battery is an association of cells connected in parallel (groups) in order to comply with the capacity request, and groups connected in series in order to comply with the battery voltage specification.

Li-ion batteries are managed by a specific electronic control system, supplied by Saft, adapted to the application requirements.

Despite being slightly more expensive (today) than secondary AgZn, the Li-ion technology will provide for HWT a much cheaper way to perform sea trial.

- Conservative values for battery life are:
  - >100 cycles
  - > 5 years
- Li-ion cells and battery do not need maintenance (Sealed cell)
- Thanks to a no load voltage reading, an accurate energy gauge can be established

Example

The full discharge of a VL27MT lithium-ion battery does not require any thermal management, even for extremely high discharge rate.

The VL27MT cell is a modified version of the commercial cell proposed by Saft for automotive applications. Modifications include:

- a tough mechanical format designed to meet military shock and vibration requirements
- the utilisation of a special electrolyte providing extended high rate discharge capabilities (4 to 12C)

The VL27MT cell is particularly well adapted to high rate discharge such as torpedo propulsion.

About Saft

Saft is a world specialist in the design and manufacture of high-tech batteries for industry. Saft batteries are used in high performance applications such as industrial infrastructure and processes, transportation, space and defence. Saft is the world's leading manufacturer of nickel-cadmium batteries for industrial applications and of primary lithium batteries for a wide range of end markets. The group is also the European leader for specialised advanced technologies for the defence and space industries. With approximately 3,800 employees worldwide, Saft is present in 18 countries. Its 18 manufacturing sites and extensive sales network enable the group to serve its customers worldwide.

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