Lithium-ion energy storage systems
for large defense applications
Saft is a recognized leader in the design and manufacture of complex lithium-ion battery systems for the industrial, space and defense industries. Saft has a strong 20-year heritage in providing both custom-built and off-the-shelf battery solutions for a multitude of applications of any size and complexity. Saft combines an international footprint with U.S.-based research and manufacturing to provide our military and defense customers with complete battery solutions from raw materials receipt to delivered systems. We maintain a fully ITAR compliant facility with mechanical, electrical, software and electrochemical expertise to serve our U.S. government and military customers.

### Program experience

Saft’s first large fielding success in the U.S. was over 10 years ago with the battery for the Improved Target Acquisition System for the TOW missile system. Since 1998, we have been delivering demonstrators and prototypes for hybrid vehicles, laser systems, underwater vehicles, and a variety of military applications.

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<tr>
<th>Saft’s Li-ion technology supplies <strong>Lockheed Martin</strong> with the world’s very first high power and high voltage aviation battery. Saft’s 270V and 28V Li-ion batteries provide start-up, flight control and auxiliary power.</th>
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<tr>
<td>Saft supplies <strong>DRS Technologies</strong> with high power Li-ion batteries to power the Integrated Fight Through Power (IFTP) system for the U.S. Navy’s DDG-1000 destroyer ships.</td>
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<td>Saft supplies its e6T Li-ion battery system to <strong>Lockheed Martin</strong> for the EMD phase of the JLTV Program. Fitting within the dimensions of a traditional lead-acid battery, the e6T powers the starting lights, ignition, and a charging dock for electronics during silent watch missions.</td>
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<td><strong>AAI’s UGCS controls Unmanned Aerial Vehicles (UAV’s) and runs on Saft’s Integrated Charger Battery.</strong> The battery provides emergency back-up power for a flight-critical function of the UGCS.</td>
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<td>The hybrid drive system of <strong>BAE Systems’ GCV vehicle relies on Saft Li-ion batteries based on our Ultra High Power cells.</strong> This new technology has shown excellent low temperature performance, while incorporating electronics to monitor the health and safety of the battery.</td>
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<td><strong>General Atomics Aeronautical Systems’ 150 kW solid state laser,</strong> the first and largest portable laser of its kind, relies on Saft’s Li-ion battery capable of delivering high power and high energy.</td>
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<td>Saft provides two batteries, 25V for instrumentation and the 100V for the utility power in the <strong>Lockheed Martin</strong> Marlin UUV. The Marlin is used to conduct subsea surveys and inspection in oceanography.</td>
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Saft’s system philosophy: total integration

Batteries built from the ground up

Saft’s systems approach ties together every step in the product development process, from conceptualization to final delivered systems, but we don’t stop there. We ensure that our delivered systems are fully integrated into our customers’ applications. The success of our customers’ programs is living proof that our energy storage systems work. Our in-house services and capabilities include:

- Safety built into every step of the manufacturing process

At the core of Saft’s systems approach to battery manufacturing is safety. Our software and electronics help users monitor the health of the battery and in many cases, automatically detect unsafe or abuse conditions to automatically shut down the system and prevent an incident from occurring.

Saft’s philosophy of total integration from cell to module to battery is the cornerstone of building a safe system.

Saft has also developed a complete suite of test equipment, calibration and maintenance tools to ensure that our battery systems meet all safety standards and customer requirements.

Software and electronics for safety and control

Saft has developed electronics and software to monitor its battery systems at every level to ensure the safe and reliable operation of our complex systems.

- System level electronics
  CANMAN® Battery Protection Controller (BPC) - serves as a communications and control interface between the battery and the host system.

- Customer Interface
  Graphical User Interface (GUI) makes it easy for users to determine the state-of-health of the battery system.

- Module level electronics
  CanProbe® circuit board - monitors cell voltages and two temperatures.
A pioneer in Li-ion for large systems

Advanced Li-ion electrochemistry at the heart of systems design

Saft’s U.S.-made lithium-ion cells are specifically designed for energy, power, or very high power applications. These cells are the foundation of complete battery systems.

**LiNiCoAlO2 (NCA) cylindrical cells**
- For long life, high value applications
- Advantages: Best power among all cathode materials, high capacity, great stability in calendar and cycle life
- Applications: Defense, space, energy storage/grid

**LiFePO4 (SLFP) cylindrical cells**
- For safety sensitive applications such as navy and motive power
- Advantages: Better safety, good power, excellent cycle life with very stable impedance, good calendar life
- Applications: Naval, motive power, and defense

**LiNiMnCoO2 (NMC) prismatic cells**
- For volume sensitive applications
- Advantages: Good power and energy, less total heat generation during abuse, suitable for prismatic and cylindrical cells
- Applications: Vehicles, motive power

### Specific Power/Specific Energy of Rechargeable Cells

From cell to module to fully integrated battery system

Saft’s systems start with Li-ion cells designed with optimized levels of power or energy. The cells are then arranged in parallel or series to form modules. The modules are in turn connected to form complete battery systems with electronics and software for safety and monitoring.

**Li-ion cells: Building blocks for complex battery systems**

**Saft’s framework for complete systems**
Customized Li-ion battery systems

Built to fit specific power and energy needs

Customer-driven design

Each military program is unique and each has a different set of power and energy requirements. A combination of extensive program experience, electrochemical expertise, world class manufacturing, and close working relationships with our customers allows Saft the capability to design each energy storage system to handle the most stringent mission requirements.

High Energy Systems

Applications:
- Forward Operating Bases
- Military Ground Vehicles
- Underwater Vehicles

High Power Systems

Applications:
- Weapons Systems
- Navy Ships
- Control Stations

Very High Power / Ultra High Power Systems

Applications:
- Directed Energy Weapons
- High Power Microwaves
- Fighter Aircraft

Modeling & Simulation capability

Saft’s modeling and simulation capabilities reduce program risk by predicting cell and pack performance under various loads and environmental conditions. Saft will work with the customer to identify the key requirements for the energy storage system and build a simulation that demonstrates the unique capabilities of the energy storage solution that meets the system’s needs.
Saft ITAR policy

It is the policy of Saft to adhere strictly to all U.S. laws and regulations covering the export, reexport, and import of Defense related articles, technical data, and services. Such laws and regulations include, but are not limited to, the Export Administration Act of 1979, as amended (50 U.S.C.), the Export Administration Regulations (EAR) (administered by the U.S. Department of Commerce), the Arms Export Control Act (AECA) (22 U.S.C. 2778), and the International Traffic in Arms Regulations (ITAR) (22 C.F.R) (administered by the U.S Department of State). Further, Saft adheres to additional restrictions on exports and reexports contained in various country-specific regulations administered by the U.S. Treasury Department’s Office of Foreign Assets Control (OFAC).