NUMBER 23 SPRING 2006

SAFT INTERNATIONAL

INNOVATION PAGE **15**

Rolling
Saft batteries help preserve beautiful city centers

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Perspective from the CEO seat

It is only Spring and yet 2006 has already seen Saft expand its operations into Asia, with a new plant coming on stream in China to meet increasing demand there, and the creation of AMCO-Saft India Ltd. in Bangalore. Saft's manufacturing network and customers are global, and becoming even more so, but our priority remains customer service, and to Saft, being global means better serving our local markets. I am pleased to say that customer

IN THE ISSUE

Saft International – A magazine for Saft's customers and business partners.
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service levels measured for 2005 were the highest we have achieved so far. We intend to continue this focus.

This edition of Saft International also highlights another major decision for Saft - partnering with Johnson Controls to enter the exciting hybrid and electric vehicle market withour new technology batteries. The potential for this market for clean vehicles is considerable, and Johnson Controls - Saft intends to become a leading player. Through the many other articles you will see that Saft continues to evolve to meet new market opportunities, to remain market leader and to bring a win-win strategy to you, our customers.

John Searle
CEO and Managing Director, Saft

STRATEGY

All eyes on Asia

High-profile visits by world leaders to Asia's two biggest nations, China and India, have focused attention on that continent more closely. **Saft, too, has been implementing a strategy — not just to visit but to have a larger footprint — in the continent.**

Saft CEO John Searle is welcomed to AMCO-Saft India Ltd. by Mr. Rajagopalan, director and CEO of AMCO Power Systems Ldt.

Economic growth is probably the most dynamic story coming out of China and India. The latter country has more than 300 million middle-income residents, a number that surpasses the total population of the United States. China continues to rack up growth rates that set world records.

Never on the sidelines in Asia (Saft has had local operations there, notably in Singapore and Hong Kong, for many years), Saft targeted opportunities in both China and India during 2005. In China, across from Macau in Zhuhai, Saft has opened a manufacturing facility to produce lithium primary and, in a second phase, railway batteries. Saft is the market leader in the first industry segment, where its products are mainly used as back-up power in electricity meters.

In the railway industry, Saft is accompanying its traditional manufacturing partners as they transfer technology and related skills to Chinese players. The rail business is just beginning to take off, as China makes critical decisions to reinforce and expand its transportation infrastructure.

Official inauguration of the new China facilities will take place in the second quarter this year.

CEOs for India inauguration

India, too, has been growing more and more prosperous. To measure up to this growth, Saft has created a new company with its long-term local partner, effective January 1, 2006. Saft has a controlling stake in the venture, which is called AMCO-Saft India Ltd. The inauguration of the company, which is based in Bangalore, India's high-tech "Silicon Valley", took place in the presence of Saft CEO John Searle and AMCO Power Systems CEO — Mr. Rajagopalan were both on hand (photo above).

The new company is one of India's major Ni-Cd industrial battery manufacturers, currently supplying batteries for local standby and rail applications. Saft will continue to supply some key components for these batteries. And the aim is to expand to support future defense aviation programs with the potential to add further military technologies to meet India's needs.

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Clearer skies for collection in Europe

With a December '05 vote by the European Parliament, a draft directive on battery collection has moved a step closer towards adoption. **Both the environment and industry will benefit from these "clearer skies".**

The draft directive will create the legal foundations for proper management of batteries at their end of life while preserving a strong European battery industry. On all the main issues, the text that has been approved is identical to what the European Council adopted in December 2004 as its "common position". This move paves the way for an easy conciliation between both institutions, driving forward to adoption of a final text. This is expected in mid-2006.

There are four main conclusions of the Dec. '05 vote, concerning extended producer responsibility, battery categories, marketing restrictions and the legal basis for member states.

Collection and recycling

Producers will have to set up collection and recycling schemes across the European Union, or EU. Mandatory collection targets are to be set for all types of portable batteries. All Industrial batteries will have to be collected and recycled at their end of life. For industrial batteries, producers and end-users will be free to enter into commercial agreements in order to share costs of collection and recycling. This is very similar to what Saft does today with its own collection and recycling programs.

Portable batteries are defined in a rather narrow way. They must meet three criteria: a portable battery must be sealed, it must be able to be carried by hand, and it must not be industrial — in other words, it must not have been designed for exclusively industrial or professional use. Since most Saft batteries are designed precisely for such industrial and professional uses, they are not classed as portable.

Environmental benefits

The draft directive doesn't introduce any marketing restrictions for industrial batteries. Portable Ni-Cd batteries can't be placed in the market, but exemptions for batteries used in emergency and alarm systems (including emergency-lighting batteries), medical equipment and cordless power tools are granted. A review of the cordless power tool exemption is slated for mid-2010.

Individual member states will not be allowed to set up tighter marketing restrictions compared to those described above, due to the EU treaty's double legal base. This guarantees the proper functioning of the European single market in terms of batteries.

Over the years, Saft has voluntarily developed a network of collection points in the countries it operates in. These partners take spent industrial batteries from Saft customers at no charge to them. The batteries are forwarded to fully authorized recycling partners. This network complies fully with the new battery directive's requirements.

So Saft, in the light of this latest directive, sees that its original collection and recycling strategy is now what the EU approves.

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STRATEGY

Power to the vehicle

Carmakers are expecting new — and exciting high-tech — power solutions from a new joint venture that Saft has set up with the U.S.'s Johnson Controls. **The two partners start off from solid bases in their home territories.**

WI, Milwaukee

Germany, Hanover

France, Bordeaux

France, Nersac

Known as Johnson Controls-Saft Advanced Power Systems, the new joint venture harnesses the expertise that the two partners have built up over the years in automotive power and electrochemical know-how. The partners signed the official joint-venture agreement on January 9 this year. The joint venture starts with operations in Europe and the U.S., but it will address worldwide non-military markets for batteries in hybrid and full-electric vehicles.

Saft is participating through its cylindrical cell expertise in nickel metal-hyrdride (or Ni-MH) battery and lithium-ion (or Li-ion) technologies. Johnson Controls is contributing its Ni-MH prismatic (or flat-cell) battery technology in Germany and its Li-ion laboratory in the U.S. along with its long-established relationships with carmakers that sell worldwide.

The aim is to deliver advanced battery solutions to automakers.

EVs and HEVs

Sales teams of both Saft and Johnson Controls are being merged, with 90 employees in all working at the creation of the joint venture. A battery management system portfolio is being built by joint-venture people at Milwaukee, Wisconsin, Hanover, Germany, and Bordeaux and Nersac, France. They combine expertise in electronics in terms of the battery management system along with an experienced industry sales force.

The result will be batteries both for electric vehicles (EVs) and hybrid electric vehicles (HEVs), which are so successful in the U.S. marketplace. Some HEVs now have a six-month waiting list of customers. Both companies see an important potential for growth in this emerging market during the coming years. This is due to the increase of energy prices but also stems from new environmental regulations that are being drafted. With its technology edge, sales network and program management expertise, the joint venture that Saft has set up has the objective of becoming the leading Western supplier of HEV/EV batteries.

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Innovation as the key to success

Markets and customer needs are constantly changing. Saft, as an innovator in high-tech battery technology, keeps ahead of the evolution by investing significantly in the future of our electrochemical expertise.

During 2005, Saft's labs in Europe and North American continued to deliver new products that the marketplace was looking for. They feature higher performance levels, longer lifetimes, greater reliability and much more. Saft maintains close continuous contacts with customers to understand what their expectations of future product characteristics are. Regular in-house technical meetings bring together Saft's international team of researchers, engineers and technicians to focus their assets more closely on what technology can deliver to customers faster. And Saft additionally maintains close relations with external resources such as scientists at universities.

Renewables

This has become a codeword for preserving the Earth's non-renewable energy resources, such as oil and gas. Saft's work in pocket-plate batteries has made them increasingly attractive for applications in such areas as solar and wind power. They serve longer, and more effectively, in hot environments.

Telecoms

With the proliferation of cellphones, operators have been obliged to install radio towers in greater density — and with assured power backup in terms of service quality. Saft is now making lithium-ion racks with easy-to-fit footprint characteristics for these applications.

Hybrid transit systems

New nickel-metal-hydride battery technologies offer traction capacity that enables urban rail operators to dispense with overhead catenaries in city centers, where preservation of cultural assets is precious.

Automatic meter-readers

Saft's lithium batteries extended their operating lifetimes for this growth application with a 10% increase in capacity. A new lithium cell boasts a 15-year lifetime in automatic meter-reading. And some lithium cells are expected to boost their capacity by 20% in just one year.

Defense

Capacity in all Saft's primary lithium chemistries is being continuously improved to deliver more power in the same volume.

Aviation

Saft is taking the lead in developing Li-ion for new defense and commercial aircraft. Its Li-ion technology will, for example, fly on the Joint Strike Fighter (JSF) F-35 jets.

Space

Operators of telecoms and broadcast satellites in geosynchronous Earth orbit (GEOs) are now convinced that Saft's Li-ion space battery technology is leading the industry. Partnership agreements [Ed.'s note: see article, p. 19] with satellite platform manufacturers in both North America and Europe, guarantee that Saft's confirmed Li-ion technology for GEO applications will continue to win market success.

Automotive

Technical expertise in nickel-metal hydride and Li-ion have made Saft and its new partner Johnson Controls a highly attractive resource for carmakers developing hybrid and all-electric vehicles [Ed.'s note: see opposite].

As always, Saft remains committed to innovation in battery technology, to ensure greater benefits to its customers. The list above is just a short selection of Saft's recent achievements.

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MARKETS

Huge Caspian oil field development relies on Ni-Cds

Kashagan — the largest oil field of the North Caspian Sea, and the largest worldwide discovered in the last three decades — will soon begin ramping up to a final production level of 1.2m barrels of oil every day. Agip KCO engineering company is the operator selected to develop 11 blocks in Kazakhstan's sector.

It has chosen Saft Ni-Cds (or nickel-cadmium batteries) for its on-shore infrastructure.

The Caspian Sea: a tough operating environment because, in part, of temperature extremes, plus the need to ensure safeguards to protect local fauna and flora. Agip KCO (a wholly owned subsidiary of Italy's ENI — "KCO" is short for Kazakhstan Caspian Operating Co.) chose Saft's subsidiary in Italy to supply Ni-Cds as part of uninterruptible power supply, or UPS, and DC power supply systems from Borri, also an Italian company.

The Kashagan project is enormous. Its development represents one of the greatest current challenges of the petroleum industry. Why?

- A deep, high-pressure reservoir;
- High sulphur content (16-20%) with associated production of hydrogen sulfide;
- Shallow waters that range in depth from 3-4 meters;
- Freezing waters from November to March;
- Sea-level fluctuation during the rest of the year;
- Temperature variations ranging from -36° C to +40° C; and
- Highly sensitive environment with a variety of internationally protected species of fauna and flora.

Agip KCO also required high reliability, long life and safe storage for the batteries. Saft's Ni-Cds were the answer.

Ni-Cd block batteries

The Saft block battery range chosen by Agip KCO is composed of modular pocket plate cells in translucent polypropylene containers. They are welded together into blocks by heat sealing, and they have a large electrolyte reserve. SBL blocks, as they are known, range in capacity from 7.5 Ah to 1540 Ah for standby energy over relatively long discharge periods. For Kashagan, the on-shore batteries from Saft will provide up to eight hours backup for gas treatment and sulphur plants.

Their "pocket plate" technology means that the positive and negative electrodes consist of rectangular perforated steel pockets. They are interlaced and pressed into a base to form a very strong plate.

Customer benefits include low overall cost thanks to the following block-battery features:

- Long, trouble-free service life;
- Low overall cost;
- Reliability — no risk of sudden battery death or thermal runaway;
- Low maintenance; and
- Large operating temperature range.

More recently, Agip KCO and Borri have asked Saft to provide more SBL pocket-plate batteries to back up telecom, satcom and main building facilities for eight hours.

Committed to development

Kashagan, as one of the world's largest oil fields, will be a project where Saft will be involved, like Agip KCO, over the long term. As the operating company says, "[We are] committed to generating value for…consortium companies and the Republic of Kazakhstan, to minimizing the impact on the unique environment and supporting the development of the local communities" where it operates.

Agip KCO also points out that it has "set up long-term education and training programs…to help generating and improving the [skills]…of technicians and professionals needed over the coming decades." Saft can only agree.

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MARKETS

Hot, hotter, hottest: Saudi telecoms backup

A Middle Eastern desert is not the coolest place to set up outdoor telecoms cabinets with backup battery power. **But Saudi Arabia's leading phone-service provider is succeeding, in part thanks to Saft's NCX, especially designed for telecoms applications.**

Saudi Telecom (STC), is deploying 100 application-specific batteries from Saft in its remote access network — the hubs through which subscribers connect to their nearest local exchange. The hubs are often just a cabinet by the side of the street, picking up phone calls, Internet chat, videoconferences and everything else that runs over the telecoms network these days.

But in the case of Saudi Telecom, the cabinets are running under the grueling heat of desert conditions, and obviously without air conditioning in the outdoor cabinets. Temperatures there can soar to +55°C, nearly enough to make most batteries bake to a grilled kebab.

Saft's batteries are different, however. STC is replacing valve-regulated lead-acid (VRLA) batteries in outdoor cabinets because of their "low reliability and premature failure", according to local sources.

World-class partners

As Saudia Arabia's leading telecoms player, STC has great ambitions. One goal is to deploy digital subscriber-line infrastructure enabling it to hook up a quarter of a million high-speed Internet subscribers by the end of the year. Dr. Badr Al Badr, general manager of Cisco Systems for Saudi Arabia, said, "The kingdom is at the vortex of rapid transformation in its telecoms sector. There is considerable demand for advanced data services" such as high-speed Internet access.

Saft's Ni-Cd NCXs are key in this service deployment, ensuring reliability through "thick and thin" — or "hottest and coldest", since Arabian nights can be quite cold, too. After successful field-trialing of a Saft NCX beginning in 2003, STC is rolling out the Saft batteries to 100 sites.

Benefits to Saudi consumers

A multitude of services will be available to STC subscribers in the future, with reliable power backup from Saft in STC cabinets. Saudi consumers will benefit from so-called "triple-play" (voice, data and video services), video-streaming, webcasting multi-player gaming and much more.

Saft's NCX was designed to fulfill the demanding requirements of remote (or outside-plant) requirements. These include local and access terminals, mobile base transcer stations, mobile base station controllers, optical node units and still more.

The NCX battery technology developed by Saft features a stable sintered electrode combined with a plastic -bonded plate electrode. Flooded electrolyte and corrosion-free chemistry drives NCX to the front of its field. It eliminates such problems known as dry-out corrosion, plate growth and thermal runaway.

Clear to STC

Longer life. (Much longer.) Predictable operation. Very low maintenance. Lower life-cycle cost. That's what Saft's NCX brings to the telecom game.

STC saw that it was clear that the NCX offer a realistic, attractive alternative to its existing VRLA compartments. And still better: installing the compact, modular NCX in STC's outdoor cabinets was simple. It fits most existing VRLA battery compartments with ease. And uses the same charging equipment.

For a company like STC, targeting "phenomenal growth", as it says, and the largest telecoms player in the Gulf Cooperation Countries (or GCC), it is definitely leadin gthe way.

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Local partnership in KSA

To deliver and install the telecoms batteries for STC's network in the Kingdom of Saudi Arabia (KSA), Saft worked with its local partner, Projects Execution Development Co. (or PEDCO), a company set up in Riyadh, the kingdom's capital, in 1991.

PEDCO specializes in DC power-supply products. For Saft's Friwo brand, it won major contracts for batteries with the Saudi Electric Co. They extended this trusted relationship to STC, a major achievement with long-term potential given the scope of STC's operations.

The acceptance of Ni-Cd batteries from Saft marks a real turning-point in telecoms DC power sources, according to PEDCO. It took place in a relatively short period, in terms of normal product approval procedures. This achievement stems from PEDCO's strong and warm relationship with its clients — and support from Saft's technical teams. "The initial order for 100 [NCX battery] strings," according to PEDCO, "is being delivered to STC on schedule and installation is under way."

Confident in partnership

PEDCO's general manager, Ziad Shaaban, notes that his company's engineers completed a special training program at Saft's manufacturing facility in Sweden, enabling them to take up the on-site challenges and grow the confidence of top figures at STC.

Shaaban hopes that this succcess will lead both PEDCO and Saft to further "long-term business prospects". He also shares the credit with Saft's Cyprus-based Middle East marketing team. "Team spirit and cooperation brought this success", he says, concluding: "We are proud to be a partner of Saft and are confident of constant success in securing more projects with this partnership."

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MARKETS

Breathing more easily

Three types of breathing-assistance equipment manufactured by France's AIROX are now reaching markets in Europe, the Middle East, Asia and North America. **They share the power technology of Saft's lithium-ion batteries, making them portable while still delivering the life-critical quality of reliability.**

Sufferers of chronic or acute respiratory failure used to have one destination: hospital. Equipment to assist them in breathing was "hard-wired" to the wall socket, severely limiting the patient's mobility while nonetheless helping ensure recovery from acute exacerbation. Now AIROX is launching SUPPORTAIR®, with patented technology that ensures that the patient breathes the right (prescribed) mix of oxygen and other medicines.

The Saft battery provides up to 11 hours of performance for users of SUPPORTAIR®, according to Christophe Hentzé, AIROX's marketing manager, and their independence can be enhanced still further with the use of AIROX's OPEN Pack®, a battery pack that AIROX vaunts as having "unlimited autonomy". (Visit www.airox.fr.)

"Now," he states, "patients can be transported around a healthcare center for exams and other treatment — free of the electric plug in the wall, thanks to our technology and most recently Saft's Li-ion batteries."

Meet the Legend

The other member of the Saft-powered trio in Airox's line-up is called LEGENDAIR®. Hentzé describes it as a "mixed ventilator integrating the whole pressure and volume ventilation modes". It can help treat most acute and chronic respiratory pathologies in both adults and children, whether the treatment is invasive or not.

For its OPEN Pack®, Airox emphasizes its small size, light weight and autonomy — all features that Saft's 25.2-V (4.4 Ah) Li-ion batteries contribute to. It weighs only 2.6 kg when equipped with two batteries. "Li-ion offers the best ratio energy stored per kilo and per liter available today," Hentzé notes. He also underscores its "gas gauge", enabling users to see clearly how much power remains, and therefore how much further autonomy they enjoy.

Distribution channels

Saft delivered a customized electronics design along with its Li-ion batteries. On the OPEN Pack®, battery charge and discharge status can be viewed on a screen that's easily visible, even in outdoor light. Because a discharged battery can be exchanged for a charged one, "the automony is large…and without limits," observes Hentzé.
AIROX's high-tech equipment is available only on the basis of a prescription from a qualified doctor or healthcare professional.

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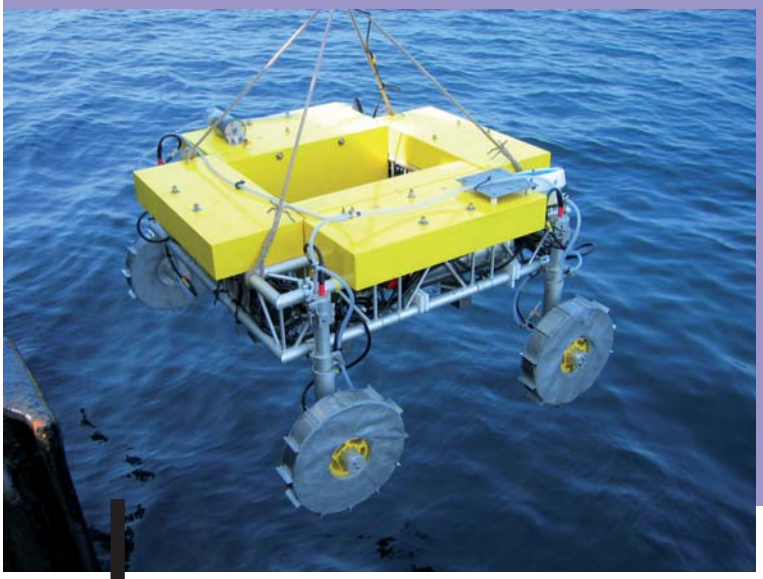
Deep space, deep sea: close cousins



Although deep space is thousands of kilometers away from the ocean depths, they have much in common in terms of the "working" environment. Explorers of seabeds face many of the same technology challenges encountered in space. **And Saft's lithium-ion batteries can be a solution for both environments.**

MOVE, an underwater vehicle developed by German and Dutch centers for marine environmental research, is designed to serve as a mobile platform carrying various scientific instruments and experiments. The developers of MOVE, which resembles the well-known Mars rovers, features next-generation technologies including Saft's lithium-ion batteries, or Li-ions. A single charge of Saft's Li-ion can provide the new vehicle with up to nine months of autonomous operation on the seabed.

"There are similar constraints [in space and on sea floors] regarding energy supply, communication bandwidth and controllability" of the vehicles, says Dr. Christoph Waldmann. Waldmann is the MOVE project manager at Marum, the German marine research center at the University of Bremen, located at a port on Germany's North Sea. On the Dutch side of MOVE, there is the Royal Netherlands Institute for Sea Research, or NIOV. "MOVE" is derived from "MObile VEhicle".

"We decided to use Saft's Li-ion battery system in the MOVE vehicle," he continues, "because it offered the ideal combination: high energy content, long life, reliability and low self-discharge."

Integrated modular battery system

From hybrid and electric vehicles to one on the sea floor, Saft's high-power Li-ion cells have adapted to the new environmental constraints of marine exploration.

Saft developed a special, modular and integrated battery system for MOVE. It's based on Li-ion cells known as "VLEs". The cells, originally developed for hybrid- and electric-vehicle (you just told that in the first sentence, please avoid to repeat) applications, pack as much power as possible into a lightweight and space-efficient package.

MOVE battery modules comprise three parallel strings of seven VLE 45-Ah cells. They provide a nominal 24 V and a capacity of 135 Ah. To withstand deep-water pressures, they are mounted in a tube. In all, four modules have been manufactured so far. These can be vehicle-mounted and connected in parallel, providing the appropriate battery duration for each seabed mission.

Their total capacity can reach 540 Ah and 13.2 kWh. An electronic control management system monitors charge and discharge voltages as well as cell temperatures.

Scientific snail's pace on purpose

Using an acoustic link to the surface, scientists check on the vehicle, retrieving status information, scientific data and video — plus still images from the onboard camera. This kind of scientific performance doesn't require high speeds.

Indeed, MOVE is specifically designed for maximum speeds of five cm (approximately two inches) a second within a range of one km (three-fifths of a mile). Its developers actually refer to it as a "crawler".

Depths can reach several thousand meters, and MOVE's autonomy of up to nine months means that "we can make repeated, long-term observations on the ocean floor," Waldmann notes, "without needing to recover the vehicle to recharge or change the battery pack."

MOVE has successfully completed sea trials in the deep-water strait that separates Norway and the southwest coast of Sweden, reaching depths of as much as 650 m. It is now moving on to carry out its first scientific missions in shallow-water regions of the North and Baltic Seas.

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INNOVATION

Power evolution in the air

In-flight power is gradually evolving, beginning with military aircraft and moving over to commercial jets. **One key aspect is the concept of the on-board battery (or batteries) as a system.**

Most future aviation programs are examining ways of reducing both mass and operating costs. In terms of batteries, this involves both the "starting" batteries — which ensure that the aircraft's auxiliary power unit, or APU can restart, to provide enough power to get engines running again — and emergency power for avionics, emergency equipment and cockpit display panels, should their power fail. (Normally the aircraft's engines turn generators that supply current; but if the engines stop, because of ingesting geese or for any other reason, the battery powers the APU into action.)

Up to now, the nickel-cadmium electrochemical couple, or Ni-Cd — in many cases with ULM® technology, developed by Saft — has been the aviation standard, approved by regulatory authorities on both sides of the Atlantic as well as elsewhere.

For some new programs, however, Ni-Cd technology will not be able to meet new weight targets. Therefore, new solutions are being brought to the aviation market.

This is why Saft has also been developing rechargeable lithium-ion (or Li-ion) batteries that can meet aviation requirements. Li-ion batteries have typically been found in portable electronics or other "Earth-bound" applications and in space. With this evolution, Li-ion rechargeables are also taking to the air.

Supplying a "smart" Li-ion battery

An aircraft's battery is a critical part of the security chain in terms of its electric architecture. Indeed, the battery is the last link in the chain. It kicks in when, in very rare cases, there's a near-total breakdown in the aircraft's power supply.

Saft has developed Li-ions for aviation applications that are "smart", comprising an intelligent battery management system along with the Li-ion cells. The system continually checks the batteries, cell by cell, and manages them in terms of charge and discharge.

This battery management principle is simple, yet sophisticated. The battery's charge manager is directly linked to the aircraft's 28-volt power network. Depending on the battery's condition and the temperature (baking hot on a desert runway, frigid cold at 40,000 feet), it determines how current and voltage should be used to keep the battery up to its optimum performance capability.

Sole power source: advantages to OEMs and airlines

Li-ion battery technology delivers many benefits to aircraft manufacturers (original equipment manufacturers, or OEMs) and airline operators: Lower weight, translating directly into more available payload, and thus more profit for airlines . Moreover, this maintenance-free technology significantly reduces the airlines operating costs..

Additionally, a single supplier — such as Saft — of both the battery and its charger environment guarantees enhanced performance of such more technical aspects as charge algorithms. These form part of a very complex process that electric system integrators cannot have a full knowledge of. Saft does. And its role as a sole battery power source supplier makes it the ideal interface for OEMs.

Defense applications in the U.S. with Saft's Li-ion have already proved their performance capabilities. Testing of commercial applications is already under way, in order to meet more complex requirement criteria in terms of certification for civil aviation

In the near future, you could be flying on aircraft equipped with Saft's Li-Ion systems, while Ni-Cd — thanks to their proven robustness and lower cost — will still be for a long period the standard aviation batteries.

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Nice will be nicer, with traction batteries for hybrid tramways

Nice, one of the city jewels on France's Riviera, close to Monaco, is adding light-rail infrastructure that features innovative hybrid energy. On the on-board battery side, there are Saft nickel-metal-hydride (Ni-MH) batteries supplied to Alstom, **the manufacturer of the Citadis trams set to ride the Nice rails with autonomous power.**

Alstom, which has delivered Citadis to several urban light-rail network operators, likes the compact source of independent power that Saft's Ni-MH batteries supply. The new hybrid trams are set to begin service in 2007.
To protect some of the most beautiful parts of Nice, the plan calls for overhead catenary lines to be eliminated, conserving the aesthetic quality of the city setting. In these catenary-free areas, Saft's batteries take over. A spacious pedestrian zone is being created at one square. Other parts of the tramway's line will be replanted with rich new trees to enhance the line's "green beauty".

Battery system expertise

Saft has developed a fully integrated battery solution for this new generation of tramways. The traction battery systems feature excellent power storage in a compact, maintenance-free package. They will power the trams through 500-meter sections where there is no catenary. They also need to be sufficiently compact for installation in the vehicle's roof. Saft's new-generation NHP batteries are ideal as they were developed specifically for high-power applications.
The battery system features several advanced technologies, including:
• A battery management control system (BMC) that communicates with the tram and controls the battery;
• An active cooling device.
The unit is supplied in a "plug-and-play" model with a custom-built tray. The entire system, managed by the BMC, communicates with, and is displayed on, the driver's dashboard.

450 Citadis operating worldwide

Citadis trams are designed to please passengers, meeting or surpassing their expectations in terms of aesthetics, comfort and easy accessibility. They draw on Alstom's extensive experience and harness the most up-to-date engineering. Their accessibility is due to the low floor of the passenger compartment, which is possible in part because Alstom, with Saft's help, is able to lodge the battery overhead.
Many cities looking to enhance their individuality as well as their public transport services have invested in Citadis; to date over 700 vehicles have been ordered.

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INNOVATION

Small (in orbit) is beautiful… indeed!

The U.S.'s Orbital Sciences Corp. has made an interesting business for itself in the small-satellite segment of the industry, for spacecraft weighing under 2,500 kg. Supporting this success are Saft's lithium-ion (Li-ion) space batteries. **They weigh less, take up less space than their predecessors, and deliver more energy.**

High-energy, flight-proven Li-ion space batteries are a perfect match for Orbital's small-in-space strategy. They also have won the interest of operators of spacecraft in geosynchronous Earth orbit, stationary (as seen from Earth) at an altitude of 36,000 km. The two most recent orders logged by Orbital have come from Malaysia's MEASAT Satellite Systems for its MEASAT-1R bird and Norway's Telenor Satellite Broadcasting for its THOR II-R. The latter will weigh about 2,450 kg at launch and well improve Telenor's service coverage all across Europe (including the Nordic countries) Europe and the Middle East.

Both satellites will have Saft's Li-ion batteries based on a stable power platform that Orbital and Saft have defined together. Dr. Ali Atia, head of Orbital's GEO satellite business, said: "Orbital is pleased to award these fourth and fifth GEO Li-ion battery orders to Saft. They extend the outstanding relationship that Saft and Orbital have developed over the past few years."

Orbital has adopted Saft's Li-ion battery design for its STAR2 GEO telecoms platform — with a total of six satellite batteries ordered for this platform within the last two years.

Orbital's STAR2 programs with Saft

STAR2, the Orbital platform with Saft's Li-ion batteries, has been winning contracts from broadcasting and telecoms operators around the world. Here are some of the recent wins along with their owner-operator's country of origin:

- MEASAT-1R —Malaysia
- Optus D1 and D2 — Singtel of Singapore and Australia
- PanAmSat11 — U.S.
- Thor II-R — Norway
- Horizons2 (PanAmSat-JSAT joint venture) — Japan-U.S.

Standardized battery design for any payload

Regardless of the satellite's power requirements (between 2.6 and 4.0 kW at payload), Orbital uses the same battery, reducing the cost that occurs when a battery needs to be customized — as has been the industry norm. This also saves OSC's customer time and money in non-recurring expenses, data generation and additional testing. Specialized design is eliminated and the parts procurement schedule can speed up, ensuring faster delivery as well as schedule and performance predictability.

Saft's Annie Sennet-Cassity comments, "It's much easier to work with some changing power loads and keep the same battery, than it is to keep changing the battery and related requirements each time."

She adds, "Orbital is the customer who was really ready to listen to Saft's recommendations. They understand that benefits to Saft in this standardized approach directly translate to benefits for Orbital in terms of product and schedule reliability as well as lower costs."

Higher bandwidth revenue generation

Payload power capability rises substantially with Saft's Li-ion on-board. (The "payload" is the on-board equipment that is dedicated to telecoms, broadcast or observation; the "platform" consists of solar arrays, batteries, power distribution and the actual physical structure that provides a home for the payload.) Thor II-R for example will feature 24 transponders with three times more payload power (3.6 kW)

compared to its predecessor. It will provide fixed telecoms and direct-to-home TV broadcasting services. The more homes it reaches, the higher the revenue for the broadcaster.

Saft's Li-ion technology enables the operator to install more power on the same satellite (compared to nickel-hydrogen electrochemistry) and so more transponders and signals to reach customers. Saft's rechargeable Li-ions power the GEOs during the spring and autumn equinoxes, when the satellite's solar arrays gradually lose contact with the sun.

Substantial weight savings

The Li-ions enable the spacecraft's manufacturer and owner-operator to save approximately 30-50% in terms of weight due to the Saft battery technology with specific energy of 120 watt-hours per kg. So more of the satellite's crucial mass can be dedicated to the payload, which is the revenue-generating part of the spacecraft.

Orbital's Atia concludes, "Saft offers high-performance, flight-proven battery technology. This is an important element in Orbital's advanced satellite design. The STAR2 has become the clear 'spacecraft of choice' in the market for satellites that require under five kilowatts of power."

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Audio à la carte: ready to shoot

In the film and TV industries, being ready to shoot is essential to delivering. Remote Audio supplies equipment that has to be ready for a shoot every time, on time. **With Saft's nickel-metal-hydride (Ni-MH) batteries, it's delivering more efficient cart-loaded audio recording solutions.**

"Waiting for sound," is, according to Remote Audio's Glen Trew, one of the more standard jokes on a set where a TV or a movie sequence is being shot. It means that the sound recording equipment isn't ready — even if it is in fact ready. So it's used for all types of excuses, whether sound-related or not.

"More often than not," Trew explains, "the audio is indeed ready, and it's the lights or something else that is blocking production. So we at Remote Audio are doing everything to ensure that recording equipment is ready when needed." This now involves Saft's Ni-MH batteries for the latest Remote Audio product, the Meon. It's being launched this April at the National Association of Broadcasters meeting in Las Vegas, Nevada, in the U.S.

Meon — a pun on "me-on", or "I'm on" — is a two-rack module on an audio cart that includes Saft's Ni-MH VHF batteries. Thanks to the Saft batteries, the Meon reduces the module's weight on the audio cart from 40 lbs (or about 18 kg) to 22.5 lbs, slicing nearly half its weight off compared to the earlier-technology power source.

Cart power trends

Saft's Ni-MH replaces a jumble of previous DC power sources. Sometimes it was a lead-acid battery with an automotive charger. Nickel-zinc batteries were often used, too. "They weren't meant to supply high-capacity current for a long period of time," Trew admits. An audio cart gets hauled around a film set, whether in a studio or outdoors, with eight to 10 items that need power. "The trend," says Trew, "is to have a single DC-power source with a battery." There's also a strip of AC plug-ins if the cart can be connected to an AC source. Meon will have 12 fused outlets that are independently protected. Because of all the "move-around" requirements of the cart, making it lighter is a key new asset that Trew applauds. When shooting on an outdoor set, the crews that run the AC generator often depart earlier, he notes. But the sound crew may have to continue working on mixing. "It's quite important to have a self-contained power source," he adds.

Saft's Ni-MH solution for Remote Audio extends beyond the lighter, more powerful and more compact Ni-MH battery.

Whole battery system

Meon comes with a 5-amp battery charger. It switches seamlessly back and forth between a direct AC power sources and the Ni-MH battery system. The latter comes with a charge controller, known as the Battery Protection and Communication Interface, or BPCI. This enables the charge of the two 12-volt Ni-MH modules which are wired in parallel to reach nearly 30 Ah. Observes Trew, "It continually monitors the battery's charge state. At full charge, it goes into a 'float' and can't over-charge or discharge the battery," thus protecting it and maximizing its operating life. And this independent function requires no intervention from the sound crews.

The first carts with the Meon prototypes with Saft's Ni-MH modules were tested during the filming of a TV series famous in the U.S. — and elsewhere — called The Sopranos. Meon and its Saft battery solution passed the tests, and they're now being launched in the North American market.

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TECHNOLOGIES

New electrode wins emergency lighting customers

Saft's R&D is delivering a new electrode technology that is initially very popular in emergency-lighting applications. It's a plastic-bonded nickel-cadmium cell that's expected to sell 4m units this year.

Emergency lighting is just the first of many applications where this new positive electrode will see service. Abbreviated as PNE, for plastic-bonded nickel electrode, the cell was launched as VNT Cs last November. In its first year, volumes of VNT sales reached more than a million units. The PNE technology strengthens Saft's position in the emergency lighting market. It reduces lead time, improves cost efficiency, and extends capacity to various cell sizes.

With the launch of this new cell, Saft also highlights its commitment to Ni-Cd technology and to its customers' demands. And it demonstrates Saft's role as the premier developer and manufacturer of high-end cells and battery solutions.

International compliance

The PNE represents a major technology breakthrough. It delivers improved energy density and a significant reduction in capacity dispersion. Applications for four patents based on the R&D used in developing these cells have been filed.

The technology of the PNE electrode meets the current severe performance requirements of the emergency lighting market. It complies with standards set by the International Electrotechnical Commission, the leading global organization that prepares and publishes international standards for all electrical, electronic and related technologies.

The lifetime of a VNT Cs cell extends out to four years, as its predecessors did. Its storage efficiency is excellent, and it can handle a permanent overcharge.

PNE extension

The new strengths of the PNE technology are several. They build on Saft's two existing nickel electrode technologies. These are the manufacture of foam electrodes using a simple, efficient process, and the use of the substrate in the existing sintering process for an electrode.

The PNE cells deliver higher specific energy (more energy per gram and volume), greater capacity and better manufacturing costs. Saft plans to extend the PNE to applications in professional electronics and elsewhere, building a complete PNE product range within rechargeable battery systems.

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In-orbit delivery: Syracuse 3A takes up post

Military satcoms, or satellite communications, took a leap forward with the service delivery of Syracuse 3A last December, just two months after it was launched. **Saft's lithium-ion (Li-ion) batteries are flying on this pioneering mission.**

In the new global environment, armed forces need more effective communications between home base and forward deployment. "We've moved from national territorial defense to [enabling] the capacity to move thousands of service personnel to other theaters, often as part of multinational coalitions," says Caroline Laurent, in charge of the Syracuse 3 program at France's defense procurement agency (known in French by its initials "DGA").

In addition to Syracuse 3A, now operational, the same spacecraft manufacturer — Alcatel Alenia Space — is completing work on its sibling, Syracuse 3B, set for launch later this year, also with Saft's Li-ions. The two satellites will form the cornerstone of a European defense satcom system shared with NATO allies.

France's latest secure military satellite is the third in geostationary Earth orbit (or GEO), after Amazonas and W3A, to leverage the technical advantages of Saft's Li-ion batteries: smaller, lighter batteries that enable a larger payload. Li-ion batteries will reach their cruising speed as up to 10 GEO communications satellites equipped with Saft batteries will be launched in 2006. As of this writing, 10 more satellites launches (with Li-ion) are scheduled for 2007 and 2008. Based on the increasingly consistent in-orbit results (with two years of experience today), Li-ion is replacing the nickel-hydrogen electrochemistry.

Space experience

Saft batteries have flown in space for 40 years, harnessing various electrochemical technologies. The first were nickel-cadmium, and those preceding Li-ion were largely nickel-hydrogen, or NiH2. The Li-ion battery stores the same amount of energy as an Ni-H2 in a smaller package, delivering a weight saving of about 50%. Operators of launch vehicles, such as Arianespace, appreciate the value of Li-ion for spacecraft platforms. (Ariane 5 also uses Saft silver-zinc and nickel-cadmium batteries for a variety of in-flight applications.) It enables them, and the spacecraft's owner-operator, to increase the operational payload.

Additionally, the European Space and France's space research center (CNES) have qualified Saft's Li-ion cells for all satellite applications.

Some six Saft Li-ion batteries for space service have been delivered for GEO 2006 launches.

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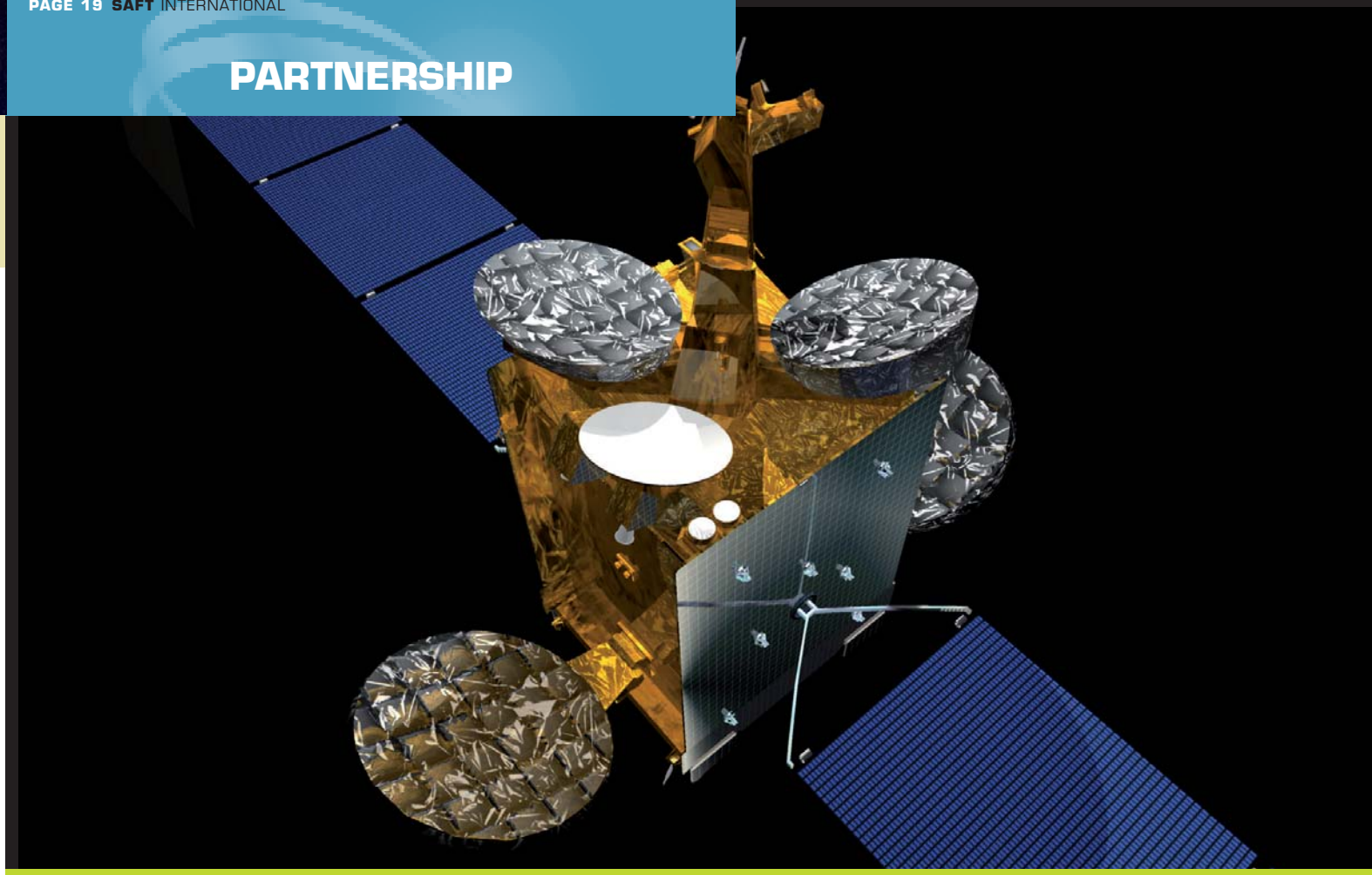
PARTNERSHIP



Eurostar spacecraft partners with Li-ion

EADS Astrium, the manufacturer of the Eurostar spacecraft platform, has selected Saft as its exclusive supplier of lithium-ion (or Li-ion) cell modules for GEO communications spacecraft batteries.

Geosynchronous Earth-orbit (or GEO) satellites are where the space-based revenue comes from for satellite owner-operators. These GEOs shower programs and telecoms services (including Internet access) over wide regions, picking up advertising and subscriber fees for their operation. The fees, however, depend on their footprint — the area where homes and businesses can pick up their service.

Stronger, more reliable batteries mean better fees. The service area grows with better power. And customers receive assured service during solar eclipses (at the equinoxes) when sun power is unavailable to a satellite's solar array. Saft satellite battery technology is crucial here. It turns on when the sun (for reasons of the eclipse) turns off. This happens during about three dozen days around the equinoxes in mid-March and mid-September.

The long-term agreement between EADS Astrium and Saft stems from close cooperation between the two partners over the last decade. The two have qualified a complete product range, and four batteries are now operating successfully on-board two Astrium spacecraft… Signed in February this year, the agreement has already become the umbrella for three contracts.

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PARTNERSHIP

Postal deliveries Europe-wide with Saft batteries

Partners from across Europe have joined forces to develop a new mobility solution for postal delivery on all kinds of terrain, whether flat city landscapes or up-and-down rural (or urban) areas. **Saft is supporting this program, known as NEPH, with its active participation and battery proposals for the systems' electric power train.**

Recognized by Eureka, the pan-Europe research and development organization, the New Electric Post Helper (or NEPH) brings together postal and platform manufacturing players from Belgium, Finland, France, Germany, Italy, the Netherlands and the U.K. VUB — the initials stand for the Flemish-language free University in Brussels — is also contributing to the project as a neutral expert. Eureka's current annual budget for transport projects exceeds €200m. (Visit http://www.eureka.be/.)

Eureka, which is backing the project financially, describes itself as "a network for market-oriented R&D". And that is certainly the goal of the NEPH players: a mobility solution that serves the market, initially in postal delivery systems and later for caddies, bicycles, tricycles…and quadricycles! All share the need for electric power assistance.

Yet postal delivery routes — the initial market which the partners are targeting — vary. A rural postal delivery person may find hills on his or her daily route, while in many urban environments the terrain is rather flat. Yet stop-and-go requirements pose a difficult challenge for the battery. It thus needs to handle both types of terrain, as well as varying lengths of delivery routes.

Demand for personal transportation systems

The NEPH players are focusing on a variety of characteristics that postal delivery personnel — and others — will expect in a personal transportation system. These include on-board payload (for postal workers that is expected to be up to 70 kg), range, performance, comfort of use, reliability and user-friendliness.

Saft is proposing a modular approach to the NEPH battery system needs, whether using nickel-metal hydride electrochemistry or lithium-ion. This system concept simplifies usage and optimizes the battery's lifespan.

Prototypes by year-end

Among the landscapes that postal delivery personnel face are ones where 70 kg of "payload" may not be enough. In these cases, there are often intermediary drop-off points where the postal authority could also leave charged batteries. The delivery person could then pick up the extra load of mail — plus a fully charged battery, leaving off the discharged battery for recharging. This is one of the delivery models that NEPH is examining.

In February, NEPH launched the development of the power train project, which will be integrated into the available platforms, with Saft as the battery advisor and supplier. The group expects to be able to deliver prototypes on several platforms by year-end for a variety of professional applications.

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NEPH participants

The following organizations are participating in the Eureka project — some postal operators and others platform manufacturers — along with Saft (photo).

- Heinzmann, Germany — motor system manufacturer
- Posteurop, Belgium — postal delivery professional association
- Biria, Germany — bicycle manufacturer
- Ludo, Belgium — bicycle manufacturer
- Finland Post — postal operator
- TPG, the Netherlands — postal operator
- La Poste, France — postal operator
- Station Italiane, Italy — postal operator
- Royal Mail group, U.K. — postal operator
- VUB — Belgian university