

SAFT

I N T E R N A T I O N A L

NUMBER 10 • SPRING 1998

NEW PRODUCTION LINE

LITHIUM-ION CELLS
WITH INNOVATIVE
FORM FACTOR

MOVING TOWARDS BETTER, FASTER, CHEAPER

At Saft, we recognize that our customers' needs have changed. With today's global markets, our customers want innovative, world-class, increasingly standardized and more competitively-priced products that can be delivered more rapidly. After all, time is money. We have undertaken **two concrete steps to meet these new demands**. First, we've reorganized internally, both to better reflect market realities and to be closer to our customers. Though our national subsidiaries will continue to play an administrative role, our three product groups — Portable Batteries, Advanced and Industrial Batteries, and Power Systems — are now responsible for worldwide product development and sales. For us, this means **greater specialization** amongst our plants. For our customers, it means **a more direct relationship** with the unit that manufactures their products. Second, we have embarked on an ambitious program

of never-ending, continuous improvement. Quite simply, **we are entirely rethinking our working methods**, in all our functions, in order to improve our productivity and efficiency. Several of our plants have already yielded **impressive results**. Productivity is up 30 percent, stocks are down 30 percent, and occupied plant surface is also down 30 percent. Similar improvements are expected for the coming six months. After that, we will continue to seek a 1 to 1 1/2 percent **productivity increase every month**, year in and year out. All of these efforts have but one goal: continuously improving our service to customers. In 1998, we hope you will see tangible benefits.

Jean Brunol,
General Manager



Peet Simard

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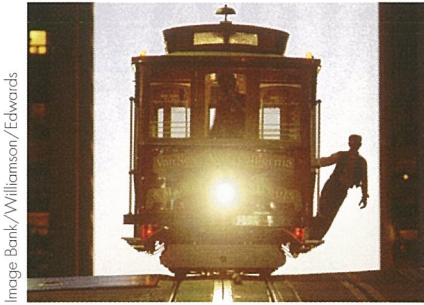


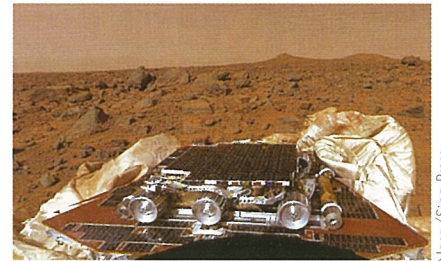
Image Bank/Williamson/Edwards

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Nasa/Sipa Press



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Today, reducing costs — production, maintenance, operating — is key to Saft's drive to develop new products and refine existing ones.



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Since its inception in the mid-'70s, the launcher Ariane has depended on Saft for all its onboard power sources. Today, Saft continues in this all-important role as Ariane enters its fifth generation.

BATTERIES MAKE INROADS INTO PUBLIC TRANSPORT

WOULD 'CLEAN' PUBLIC TRANSPORTATION SYSTEMS HELP REDUCE URBAN POLLUTION? YES, SAY SAFT ENGINEERS AND EXECUTIVES, WHO ARE PUTTING MUCH EFFORT INTO DEVELOPING VIABLE ELECTRIC SOLUTIONS FOR SUCH APPLICATIONS.

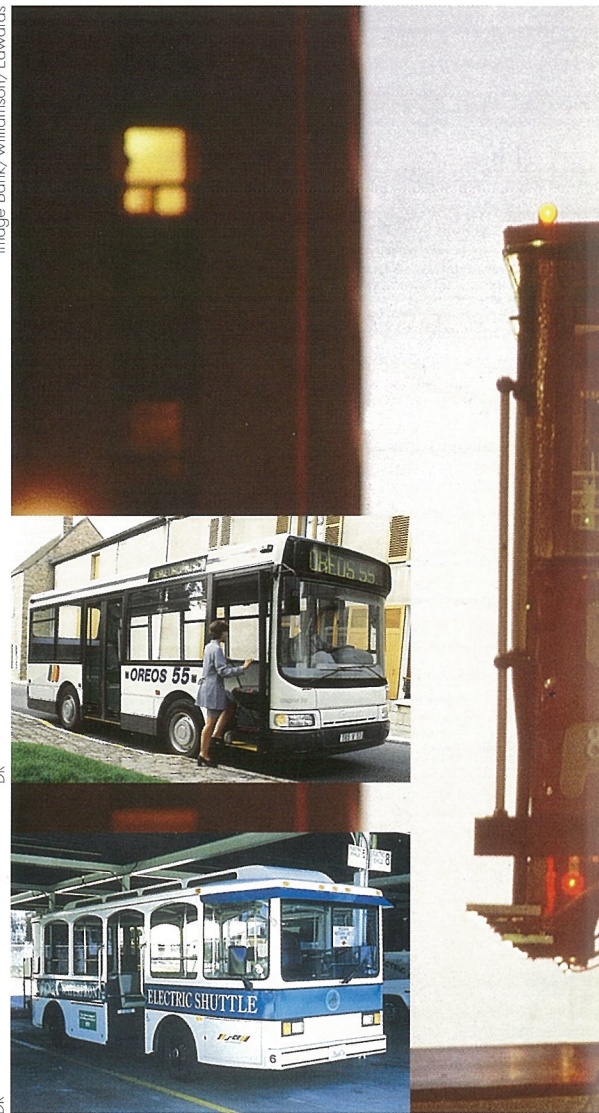
City-dwellers at the end of the 20th century cannot escape the fact that traffic congestion and pollution go hand-in-hand and seriously affect quality of life. To reduce both of these nuisances, municipal authorities are seeking to make public transport an appealing alternative to individual car travel. This is a challenge in many countries; in France, for example, barely 10 percent of daily travel is undertaken through collective means. But can municipalities use environmental arguments to encourage public transport usage when virtually all buses are diesel-propelled? True, public transport contributes far less to overall urban pollution than do individual cars. Nonetheless, "users, who are also voters, are making strong demands for public transport to lead the way in this arena," says Philippe Ulrich, Saft's marketing director for advanced batteries. **There is good reason to believe that today, political will and user interests are converging.** "We've been following this market for four years and the demand for solutions is increasingly well-articulated," Ulrich says. It remains, however, embryonic. "There has yet

to be a major contract in this domain with a major transport system," says Lou Magnarella, sales manager for bus batteries for Saft in Valdosta, Georgia. "An order for six to ten buses is a big order; the average is around two to five." Nonetheless, projects abound. **"There are two major 'concepts' being applied to public transport: electric traction and liquified gas,"** explains Fred-Eric Hapiak, marketing director for the transportation division of Saft's advanced and industrial battery product group. This fuel, which pollutes less than diesel, "is neither very economic nor completely safe," stresses Ulrich, but it allows operators in cities like Paris and New York to put a new vehicle into service within three months of ordering it. Saft's electric solutions, be they all-electric or hybrid, are more complex to implement. According to Ulrich, though, they are 'cleaner' and more economic in the long run.

MARKET SEGMENT SUCCESSES

So far, Saft's electric solutions have had visible successes in two particular market segments: mid-sized buses that travel a limited number of kilometers along specific routes, and hybrid or bi-modal buses and trolleys. In the U.S., three all-electric buses are used to shuttle visitors from one viewpoint to another in the Grand Canyon. According to

Image Bank/williamson/Edwards



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Magnarella, these buses are so popular that the operating company plans to make its entire fleet a 'clean' one over the next few years. Electric buses also serve the California beach routes of Santa Barbara, Santa Monica (which plans to order four more vehicles) and most recently, Burbank. **Saft provided the Ni-Cd batteries for all of these buses.** The Montmartrobus is another example.

Saft's electric Montmartrobus has proven successful in a restricted Parisian quarter since its 1996 introduction.



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there not a corresponding demand in the field. In France alone, there are at least 11 projects in the works for this type of application all over the territory.

Hybrid traction is also a fast-developing alternative to regular thermal engines.

Hybrid propulsion features an electric battery that works in tandem with a smaller thermal engine. The battery provides the power for engine start-up, which thus eliminates the clouds of black smoke diesel buses leave as they make their exits. There are hybrid buses planned or in operation in the U.S., Sweden and Denmark.

REPLACING CATENARIES

Hybrid solutions are also used to reduce 'visual' pollution.

"Today, we are trying to eliminate tramway catenaries — particularly in historic city centers — by replacing them with batteries that are used only for short distances," says Ulrich. These bi-modal trams — or trolleybuses, if they run on wheels rather than on rail — are in operation in Milan and San Francisco. In this latter city, Saft furnished the first 60 cars with Ni-Cd batteries five years ago. The program has been so successful that the city's transport authority is looking to add another 300 bi-modal traction cars. Car and bus manufacturers are also examining innovative options. In Saint-Quentin-en-Yvelines, France, Renault is renting similar cars to employees of its local plant so that they can access it from the local public transport station. Peugeot is doing something similar with its Praxitel project. And the San Francisco transport authority has a test project in which users can rent small electric cars to travel between the public transport station and their homes. **Such initiatives are beginning to appear as key links in overall public transport policies.** They put electric traction at the heart of a truly multi-modal strategy for cleaner, more fluid city centers. ●



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This mid-sized experimental vehicle has successfully navigated the narrow and steep streets of this Parisian tourist haven since February 1996. Michel Bouton, director of the vehicle division for Ponticelli, the company that manufactures the bus, says **the Montmartrobus "has been very successful, both in terms of the vehicle and in terms of the battery."** Thanks to such positive response, Ponticelli

has developed an entirely new vehicle, the Oreos 55E, designed from the start to be electric (the Montmartrobus was adapted from a diesel-propelled vehicle). Ponticelli will produce this 50-seater on an industrial basis. "We plan between 20 and 30 vehicles for 1998, and eventually, 40 to 50 a year," he says. Of course, Ponticelli would not embark on production on an industrial scale were

CONTRIBUTING TO OUR CUSTOMERS

ON LAND, IN THE AIR, UNDERWATER — EVEN ON MARS! — SAFT BATTERIES AND POWER SYSTEMS PROVIDE NECESSARY ENERGY FOR AN IMPRESSIVE VARIETY OF APPLICATIONS. SAFT OFTEN USES EXPERTISE DEVELOPED IN ONE SECTOR AND APPLIES IT TO OTHERS.



Creating Web links with Saft customers

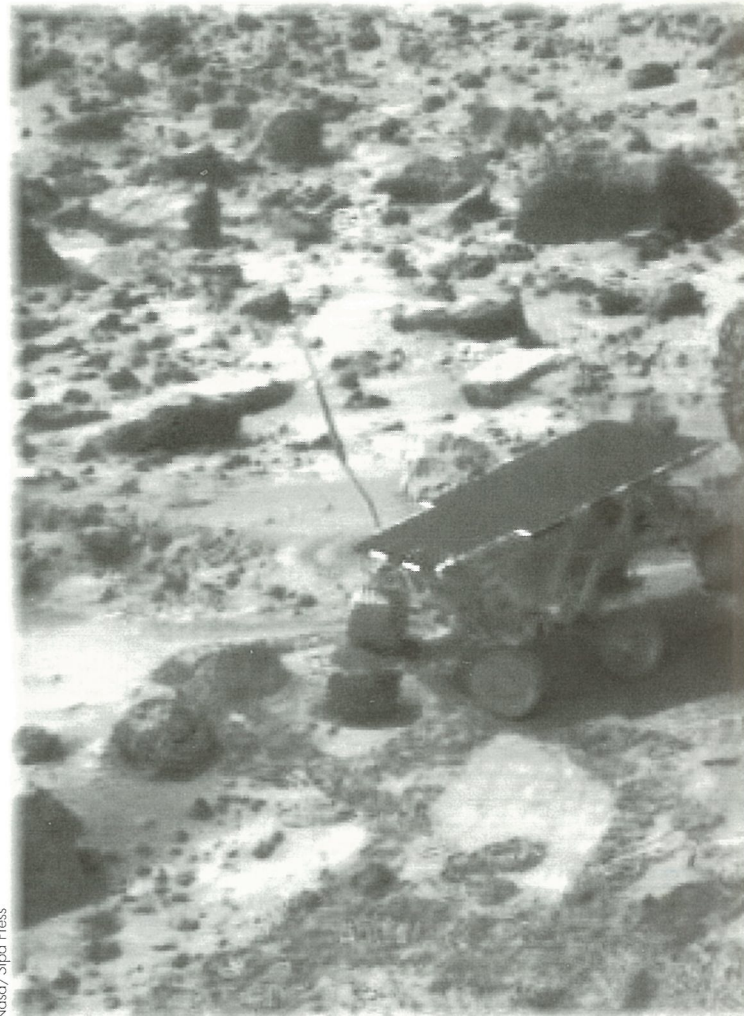
Saft customers gained access to a new service with the company's new bilingual Web site. Roland Bourgeois, corporate communications director, notes, "The site allows us to present the company according to our

customers' interests. We structured our specifications to requests we were already getting." The site allows customers to size their batteries online and will soon allow them to download certain maintenance data sheets (with password). To ease navigation, the 1500-page site features a tool bar that covers six options: company profile, search, hot news, archive room, contact and your

business field. Other key features include an integrated search engine and the possibility of sending e-mail to a contact. "We want our site to be an online service tool," says Beatrice Paccoud, product communications manager and Internet project leader. She adds that it will be updated regularly with technology information, conference texts and events listings. ● <http://www.saft.alcatel.com>

“Our battery onboard Sojourner performed beyond our expectations. It showed just what a battery could do in the most austere conditions.”

Bob Staniewicz, *Scientific advisor for the advanced technology division of Saft's Industrial Battery Group*



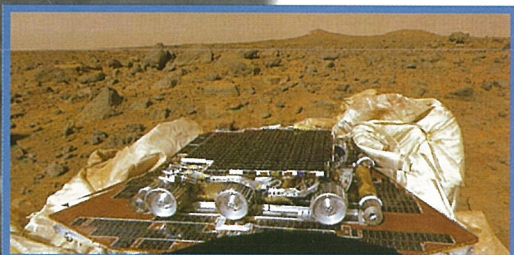
Nasa/Sipco Press

MEETING THE CHALLENGES OF A MISSION TO MARS

Saft batteries were onboard Sojourner, the Mars-exploring rover that spent a full four months analyzing the Red Planet's surface, taking 550 images and sending millions of data bits back to earth via the Pathfinder spacecraft. Designed by Jet Propulsion Laboratories, Sojourner was powered by a solar array, but Saft primary Lithium thionyl chloride (Li/SOCl₂) batteries kicked in when the sun went down. They also provided power for periodic 'health checks' during the seven-month cruise from Earth. This was an unprecedented experience for Saft. "We had two key challenges," says Bob Staniewicz, scientific advisor for the advanced technology division of Saft's Industrial Battery Group. The first was that the flight cells had to be built two

RS' SUCCESS

Sojourner exploring Mars, with the help of Saft batteries.



Nasa/Sipa Press

years before they would deliver electrical power on the Mars surface. Saft therefore had to ensure that they would not suffer from electrode passivation. "The second challenge was integrating into the JPL team, which wasn't sure what the final structure of the battery would be," he says. Saft had to test different glues, ceramics and tube structures to see how they would withstand the shocks, vibrations, centrifugal forces and heat variations the trip entailed. As JPL Rover operations coordinator Matthew Wallace wrote to Saft, "the Rover lithium batteries...required first-of-a-kind development work. This was particularly true of the battery packaging, which was engineered in near real-time to accommodate the aggressive project schedule." Thanks to such stellar performance, Saft has now received a contract to provide primary batteries for JPL's Starduster program. ●

Vodafone expands with partner H&S

Vodafone, the U.K.'s largest cellular telephone operator, is adding an extra 350 GSM base stations to its network — and is once again counting on SM1800 cubicles from Saft affiliate Harmer and Simmons for power. "Vodafone is now going into parts of the country where cellular reception has been a bit suspect," says Norman Kerridge, the field sales engineer responsible for the account. "With this



Image Bank/Larry Dale Gordon

added coverage, they are targeting businesses whose employees can call the office from anywhere in the country." Harmer and Simmons has been working with Vodafone for about ten years. In addition to

providing the power systems for these new base stations, the company provides regular upgrades for Vodafone's installed network, which is now being moved from analog to digital switching systems. "The number varies according to traffic, but we supply between 100 and 150 cabinets per year each equipped with up to 3xSM1800 rectifiers," says Kerridge. Roughly 25 percent of the U.K. cellular infrastructure market relies on H&S power systems. ●

ULM lightens helicopter's financial load

Saft's Ultra-Low Maintenance Ni-Cd batteries are providing engine starting power and emergency energy on the newly developed EC 120 helicopter, jointly produced by Eurocopter, Singapore Aerospace Technology and CATIC, China's international trade office. "The ULM range's primary objective is to reduce life cycle



Jérôme Deullin

costs," says Richard Maurice, who is responsible for the international aviation market in the Advanced and Industrial Batteries Group. This factor was key for the Eurocopter consortium, which examined every possibility of reducing the operating costs of this new, small helicopter in a crowded market. "We designed the helicopter so that we

could price it competitively," says Christian Soulié, purchasing manager at Eurocopter. Moreover, Saft's ULM battery "combined both new technology and lower costs." First deliveries of the EC 120 are planned for the beginning of 1998. The consortium is expecting to produce about 1600 units of this helicopter. ●



Bombardier

For trains by Bombardier, Saft's small SRMs fit best

Saft is supplying SRM nickel-cadmium batteries for back-up power on 70 driverless light rail vehicles being built by Bombardier for the PUTRA LRT System Line 2 in Kuala Lumpur, Malaysia. The Saft SRM batteries will back-up the trains'

low-voltage power supply for up to one hour in the event of failure of the network supply. Among the vital automatic systems backed up are emergency lighting and ventilation; train and door control; communication, safety and security equipment and systems; and propulsion and brake control.

Bombardier's ART Mark II is a relatively compact vehicle, leaving little room under the carriage floor for batteries. The SRM's height of just 347 mm was therefore of critical importance. Indeed, conventional nickel cadmium cells would have been too tall for this application. Other factors were also key: safety, battery weight, capacity to function in high ambient temperatures and Saft's ability to provide local training and support. ●



Image Bank/Guido A. Rossi

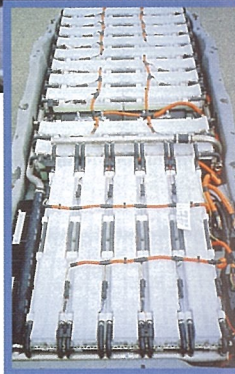
H&S partner supplies top Malaysian GSM operator

Binariang, one of Malaysia's top three cellular operators, is relying on no-break DC power stations from Harmer and Simmons partner Exsel in Singapore to power the base stations in its GSM network. H&S has supplied Exsel with an initial £600,000 of switchmode rectifiers for its systems. "Our rectifiers are the heart of these systems," says Steve Parrott, sales director for Saft power electronics. "They represent only 15 percent

of the system's volume, but are 30 to 40 percent of the value." Having such partnerships enables H&S to be competitive globally. "We couldn't compete if we had to ship full power cabinets from the U.K." Parrott explains Binariang's choice of Exsel: "We'd already supplied power systems for their early installations, so they were familiar with the product; they have excellent relations with Exsel; we put in a very cost-effective bid." ●



We anticipate supplying Chrysler with NiMH batteries for up to 2000 vehicles between 1998 and 1999." Michael Saft, *director of sales and marketing at Saft's Cockeysville Research and Development Unit.*



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FIRST PRODUCTION ORDER FOR NiMH BATTERIES IN U.S. CARS

For the first time in the United States, a major car manufacturer has issued a production order for Saft's nickel metal hydride (NiMH) batteries.

After careful evaluation, Chrysler has decided to use the battery in its Electric Power Interurban Commuter (EPIC) minivans.

Chrysler plans to sell these electric minivans in the states of California and New York.

In New York, state authorities have mandated that as of 1998, 2 percent of all cars sold by automakers must be electric. "As long as this mandate holds up, we anticipate supplying Chrysler with NiMH batteries for up to

Easy recharge for electric vehicles

Thanks to a multi-year contract, Saft is equipping Bombardier's Neighborhood Electric

Vehicle (NEV) with a unique feature: an onboard charger. "The advantage of having the charger onboard," says John Tuerk, product manager for Motive Chargers at Saft in Canada, "is that users just drive up to a standard electrical wall outlet and plug in." It then takes ten to twelve hours to recharge the

main vehicle battery. Bombardier, the world's largest manufacturer of snowmobiles and individual motorboats, is targeting the NEV mainly at retirement and gated communities in the US. "These communities are popping up all over the place," says Tuerk, who credits aging baby boomers with this profitable trend. They are ideal for the Bombardier NEV because speed limits within their confines are very low, he adds. The first 3,000 chargers have already been delivered to Bombardier. Tuerk says volumes should increase dramatically once the company's NEV production reaches full speed in May 1998. ●

Saft helps U.S. Navy in submarine detection

In any given year, the United States Navy drops between 20,000 and 30,000 sonobuoys into the ocean in order to practice positioning and targeting 'enemy' submarines. These buoys are only as reliable as their batteries, which give the 30 amp pulse that makes the sonar 'ping', and then listen for the echo of that 'ping'.

"Saft has been supplying Spartan Electronics with L030 SHX lithium cells for the last 13 years—the last four as sole source," says Glen Bowling, project manager in Valdese, NC. This year (until March 1998), Saft will supply Spartan with about 400,000 cells, which it ships just-in-time every two weeks, to equip 36,000 batteries and buoys. The cells must have a minimum of 1.65 volts at 30 amps and must perform its pulses at a 20 percent duty-cycle for one hour. Moreover, they must be able to function from 0° to 55° and have a five year shelf life. "In fact, the batteries we are delivering last more than 10 years," says Bowling. ●



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Bombardier

Saft NiMH batteries will be used in Chrysler's "EPIC" electric minivans.

2000 vehicles between 1998 and 1999," says Michael Saft, director of sales and marketing at Saft's Cockeysville Research and Development Unit. Saft developed its battery under the sponsorship of the United States Advanced Battery Consortium (USABC).

It features an improved energy density with twice the life of today's average lead-acid battery. The battery is also maintenance-free. In order to meet the contract's requirements, Saft plans to expand its manufacturing capacity for advanced NiMH batteries. Saft has already begun delivery of Chrysler's batteries, produced at Saft's EV battery plant in Bordeaux, for vehicle integration and qualification. ●

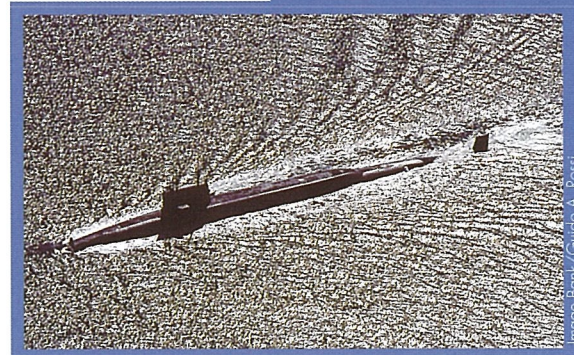


Image Bank/Guido A. Rossi

A SAVVY APPROACH TO PRODUCTION

SAFT HAS ALWAYS GIVEN ITSELF THE MEANS NECESSARY TO ACHIEVING ITS GOALS, WHETHER IT BE INVESTING IN NEW FACILITIES OR OPTIMIZING EXISTING ONES. THE RESULT? NEW PRODUCTION LINES AND A PROGRAM THAT IS YIELDING DRAMATIC IMPROVEMENTS IN PRODUCTIVITY.

Flexible AAA line targets OEM telecoms market

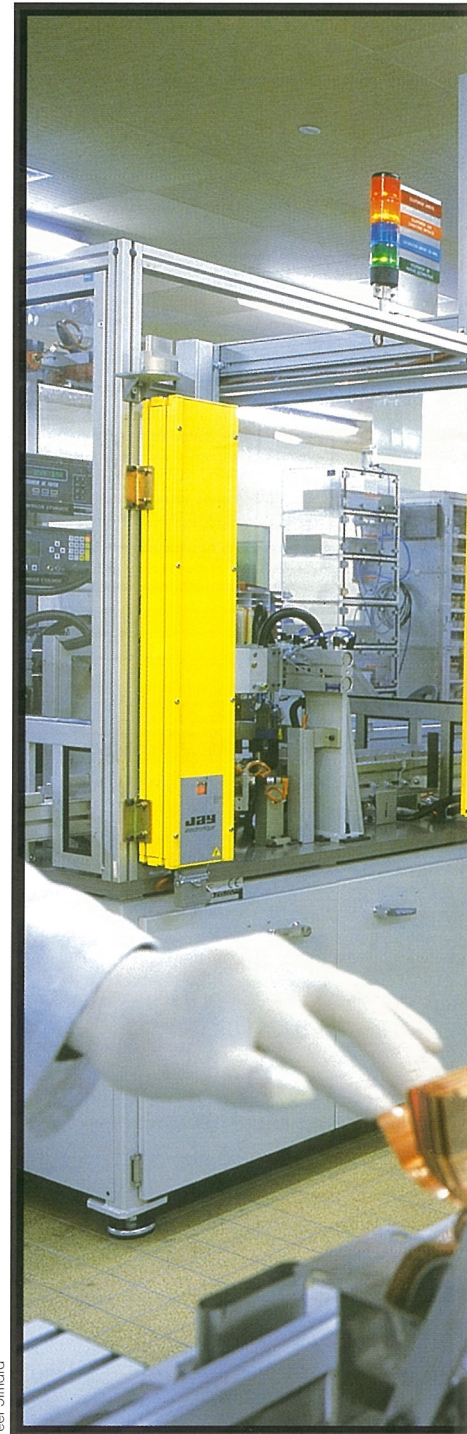
Soft has inaugurated its first flexible AAA Ni-MH battery production line in Tijuana, Mexico. Targeting telecoms manufacturers of middle-range portable products, the line is the first phase of an \$8 million investment program that will enable Saft to produce 24 million of these cells annually. The plant should reach full capacity by the fourth quarter of 1998. Saft has long served the OEM telecoms market with small prismatic batteries. Today, "a portion of this market is moving towards cylindrical batteries, both AA and AAA,



because they are less expensive," says Jean Coibion, vice-president of manufacturing for Saft Portable U.S. The total market for these types of cells is expected to reach 150 million in 1998. The Tijuana line, which came onstream in August, can produce 8 million AAA cells yearly. Two other lines, slated for the first quarter of 1998, will complete the investment. All three lines are flexible, which allows Saft to adapt them easily to eventual height evolutions. ●

SAFT UNIQUE IN PRODUCING LI-ION CELLS IN MP FORMAT

Soft's new prismatic lithium-ion production line in Poitiers is now starting up and should attain its cruising speed by the middle of 1998. Saft is thus the only company in the world to produce rechargeable lithium-ion cells in a medium prismatic (MP) format. Based on a large-cell concept, the MP form is designed to replace three cylindrical batteries placed side-by-side. The advantage? There is no empty space between the cells, which means greater volumic and massic energy and less self discharge. Saft is targeting three specialized markets with this new-form prismatic Li-ion cell: military radiocommunications (see Innovation), high-end requirements for portable telephones, computers and handheld terminals. It has already signed a first contract with Alcatel. "We are targeting the upper range with this product," says Richard Doisneau, Lithium-ion MP project manager. "OEMs will offer it to their customers as an option." For the PC market, "we are targeting manufacturers who seek to position their products as having both greater autonomy and reduced thickness," Doisneau continues. Finally, for military radiocommunications, in addition to the advantages proper to lithium-ion, the MP form "avoids having to multiply the number of cells. Here, they are particularly sensitive to weight issues," he explains. ●



Peel Simard

“This new medium prismatic production line allows us to enlarge our range of lithium-ion batteries.”
Richard Doisneau,
Lithium-ion MP project manager

TIVITY

Saft's new prismatic lithium-ion production line in Poitiers, France, should attain optimal speed by mid-1998.



U.K. manufacturing plant dramatically improves production processes

The U.K.-based Harmer and Simmons plant, which produces DC power systems for telecom applications, has

director, explains, "we had a real challenge meeting inventory targets. For years, H&S had worked on a 'just-in-case' mode, and we now had to move to 'just-in-time,' buying only what was needed, when it was needed." Nonetheless, the company reduced inventories by 32 percent in just six months.

In terms of manufacturing quality, the company focused on its rectifiers. Defect rates were reduced in some areas by 80 percent, and overall productivity improved by 26 percent. Finally, the entire sales administration, design, manufacture and project management team for systems manufacturing was integrated into one office, which reduced not only internal errors but lead times for customers. ●



implemented new work methods that have yielded significant improvements in its manufacturing performance. These measures were undertaken as part of a Saft-wide program to dramatically improve productivity as well as to reduce space and inventories. H&S's efforts got underway in June of 1997. By the end of August, the plant had sold little-used or non-cost-effective machines, moved assembly lines closer together and removed excess inventory, leaving 26 percent of the plant floor space unused. Another 50 percent improvement is expected by end of June 1998. Neil Reed, operations

CUSTOMERS' NEEDS DRIVE SAFT

THERE IS NO TRUE INNOVATION WITHOUT CLOSE ATTENTION TO CUSTOMER NEEDS. TODAY, REDUCING COSTS — PRODUCTION, MAINTENANCE, OPERATING — IS KEY TO SAFT'S DRIVE TO DEVELOP NEW PRODUCTS AND REFINE EXISTING ONES.



Thomson

Saft helps military with new lithium-ion cell

Thanks to its new medium prismatic (MP) lithium-ion cell, Saft is now the only non-Japanese company to offer rechargeable lithium-ion batteries for military radio-communications, says

Thierry Faugeras, marketing manager for Saft's lithium and military division. Armies have long relied on primary lithium batteries. But budget cuts have spurred a search for less costly options for day-to-day training. The Li-ion MP cell, with both military and civil applications, allows armies to benefit from economies of scale. The MP's prismatic shape, coupled with the performance benefits of lithium-ion, brings gains in energy density and

capacity over technologies now used. This form/technology pair "gives it three times more watt hours than a D-sized Ni-Cd battery," says Faugeras. When compared to three cylindrical VL 18650 Li-ion cells, a single MP cell offers 18 percent more capacity, cost reduction and higher reliability on battery assembly. The MP, produced on an industrial scale, has interested European armies. Sweden's qualification tests have confirmed the battery's advantages. For U.K. Ministry of Defense, the Li-ion version of the Clansman Ni-Cd battery integrates the charger inside. Saft is also developing a Li-ion battery for Thomson's radiocommunications terminal, PR4G. ●



PSA Peugeot Citroën

LITHIUM-ION MAKING INROADS IN THE EV MARKET

The joint government/industrial research program on electric vehicles Vedelic has had a major success: for the first time in Europe, a prototype electric Peugeot 106 equipped with a Saft lithium-ion battery has successfully completed a test run.

The door is now open to phase two, where one vehicle will integrate both the lithium-ion battery and a newly-tested electric traction system.

"This new vehicle will allow Saft to prove the performances it has committed to," says Pierre Morhet, Lithium-ion for EV's program manager. Indeed, the Li-ion battery, working in tandem with the new traction system, will bring EV autonomy to 200 km for a cruising speed of 110 km/hr.



Saft will be able to demonstrate the performances it is committed to — 200 km of autonomy at 110 km/hr — in phase two of the Vedelic research program on electric vehicles."

Pierre Morhet, Lithium-ion for EV's program manager

INNOVATION

Maintenance-free battery for F-22 Raptor

Lockheed Martin's F-22 Raptor, the U.S. Air Force's new generation of fighter plane, is the first aircraft to use Saft's aircraft maintenance-free batteries (AMFB). Del Nary, direct military program manager in Valdese, says, "it's the



first time maintenance-free batteries can operate at this level." The AMFB is designed to go a full two years without being taken off the aircraft. Part of the charger control system supplied by Smith Industries Aerospace, the sealed-valve regulated Ni-Cd batteries supply electrical power to start up the F-22's auxiliary power unit, which in turn starts up the main engine. The battery also supplies emergency fill-in power

and fulfills ground check operations. Saft's AMFB can perform these functions at temperatures that range from -40°C (few batteries can achieve this) to +63°C, which is much higher than most aircraft require. This factor and Saft's own ability to manage the project (delivered one month ahead of time) won praise from Smith Industries and Lockheed Martin, which will produce 339 of these aircraft. ●



This improves today's EV performances, where Ni-Cd batteries offer 80/90 kms of autonomy for a cruising speed of 90 km/hr.

"For a battery of the same mass and price, you can drive almost two-and-a-half times as far without recharging...This is why car manufacturers expect so much from this technology," says Morhet. Indeed, "Saft's lithium-ion battery offers the most attractive power/energy ratio required by electric traction," says Joseph Beretta, who is responsible for EV research at PSA. "Best of all, I can use it both for electric vehicles and hybrid vehicles." Vedelic is a \$15 million program jointly financed by the French Ministry of Industry, the Poitou Charente Region and the European Union. It also has the participation of industrial players such as Saft, PSA Peugeot-Citroen, EDF, Sagem and Leroy-Sommer, among others. ●

Proving high-powered lithium-ion's worth

Saft's research on high-powered lithium-ion for hybrid electric vehicles has been cited by the U.S. National Research Council (NRC) as one of the highlights of its Partnership for a New Generation Vehicle (PNGV) program.

The purpose of this multi-billion dollar program, which runs till 2002, is to build a vehicle with three times the efficiency of today's mid-sized car. Saft's two-part, \$9.8 million contract has so far yielded impressive results: Saft has

demonstrated that HPLI cells exceed PNGV power, energy storage and cycle life requirements. The next step will be to meet a comprehensive safety evaluation and scale up to 10-20 Ah cell sizes. ●



REACHING FOR THE STARS: LA

IN THE MID-'70S, THE EUROPEAN AND FRENCH SPACE AGENCIES (ESA AND CNES) MANDATED A CONSORTIUM OF COMPANIES TO BUILD THE FIRST EUROPEAN COMMERCIAL LAUNCH VEHICLE, ARIANE 1. SAFT, AS SUPPLIER OF ALL ONBOARD POWER SOURCES, WAS A PARTNER THEN, JUST AS IT IS TODAY AS ARIANE ENTERS ITS FIFTH GENERATION.

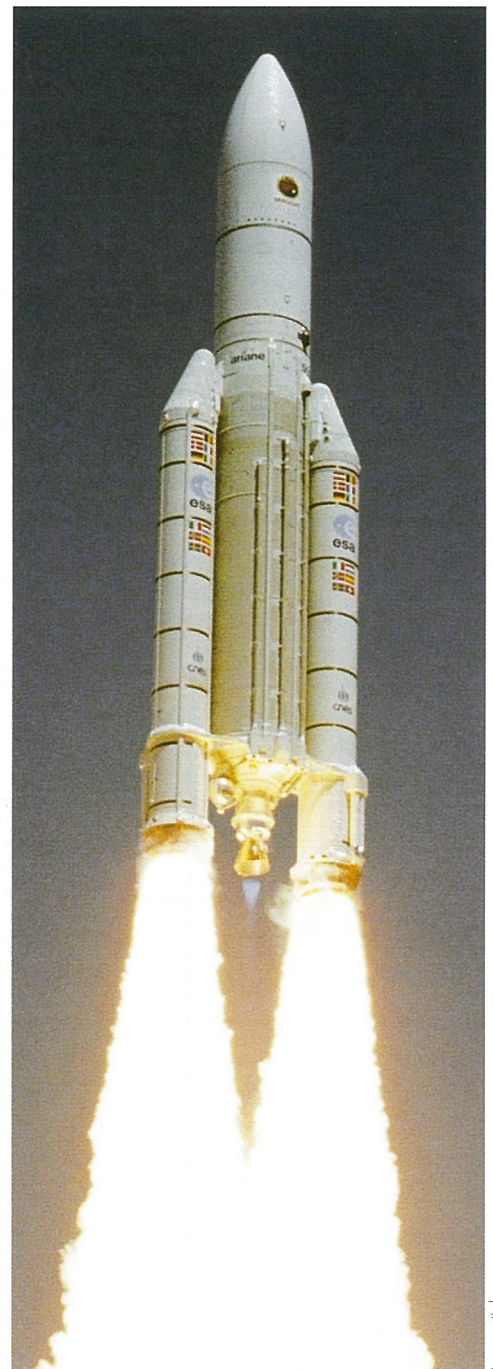
Saft in space

Saft has been producing batteries for space applications since the 1960s, when it started supplying ESA and the CNES with Ni-Cd batteries for satellites. As one of only two battery competitors for this sector, Saft has since gone on to supply all five generations of the Ariane launcher. "We have about 15 to 20 percent of the overall space market share," says Annie Sennet, marketing manager for space in Europe, Asia and Africa. In addition to Ni-Cd batteries for space launchers, Saft also supplies silver zinc and lithium thionyl chloride batteries, the latter ones notably for the Titan IV Centaur upper stage. In satellites, Saft supplies Ni-Cd and nickel hydrogen batteries — most recently for the Swedish Sirius II satellite. Saft is also starting to supply lithium-ion for satellite applications. ●

Getting a 700-ton space launcher off the ground and into space is no easy task. Yet it is something Arianespace, the company which operates and markets the Ariane launches, has done with impressive success since 1979. Indeed, it has come a long way since that first, momentous flight: 180 launch contracts from 50 operators worldwide; 165 satellites put into orbit thanks to 104 launches (the most recent being on December 20, 1997); and a resulting 60 percent of the available market for commercial satellite launches. But the company and its industrial partners are not resting on their laurels. American, Russian and to a lesser extent, Chinese space transportation companies are providing Arianespace with newfound competition. Moreover, an ever-expanding number of private telecommunications operators, coupled with a growing user demand for mobile and multimedia services, have boosted demand for satellite launches. "Just five years ago, there were about 20 satellites launched per year," says Mario de Lepine, media relations director for Arianespace. "Today, that figure has gone up to 30."

SERVICE FEW CAN MATCH

To maintain its competitive advantage, Arianespace seeks to continually improve service to its customers. "Today, we can accommodate a client wanting to launch a satellite within 18 months to two years," says de Lepine — service few others can match, he adds. Moreover, Arianespace has learned to inject a satellite into orbit with greater precision, thus increasing a satellite's life expectancy from 13 to 15 years. For many operators, this extra two years all but pays for the launch, which



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Aerospaciale

UNCHER ARIANE 5 TAKES OFF

varies but is in the \$100 million range. It is within this framework that the fifth generation of Ariane launcher was developed. Ariane 5, which must complete a second qualification flight in the spring of 1998 before starting commercial service later this fall, is a departure from the current Ariane 4 vehicle. Notably, Ariane 5 features a single cryogenic stage that is 15 times as powerful as the third stage of Ariane 4, and two solid booster stages — the largest ever built in Europe. Together, their power allows the launcher to put into orbit greater mass (6.8 metric tons vs 4.7 metric tons for Ariane 4).

SIMPLER, LESS COSTLY ARIANE

Moreover, “Ariane 5 has a reliability level that is compatible with manned flights,” says Bernard Alquier, who is responsible for power systems aboard Ariane 5 at Aerospatiale, Ariane’s industrial architect and prime contractor for several stages. “For maximum security, all equipment is double, including power sources.”

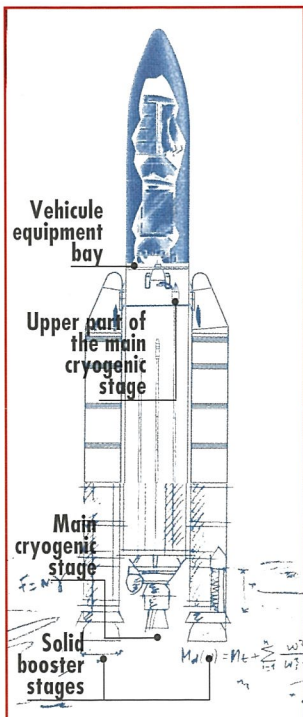
But above all, Ariane 5 is simpler and less costly than Ariane 4. “Our goal was to make a more powerful but simplified and less expensive launcher, with fewer stages and fewer engines,” says Shirley Compard, press relations manager for Aerospatiale. This simplicity applies to its components as well. Saft, for instance, is supplying fewer types of batteries than it did for Ariane 4, which used four different types of nickel-cadmium batteries and two different types of silver zinc batteries. Ariane 5, though, uses only a single type of Ni-Cd module and a single type of silver zinc battery. Indeed, this latter battery was designed specifically for the new program and took as long to develop as the launcher itself (development began in 1990). Ariane 5 will enable Arianespace to gradually increase its launch capacity by 50 percent. Ariane 4, for its part, will continue to be used until 2002; indeed, Arianespace has just issued an order for an extra 20 Ariane 4 launch vehicles to meet current demand. ●

Aerospatiale as industrial architect

“A launcher is an all-or-nothing operation,” says Shirley Compard, Aerospatiale’s press relations manager. “Everything has to work.” As industrial architect for the Ariane program, it is Aerospatiale’s responsibility to see that it does — seamlessly and perfectly. This entails all system engineering, interface management, the flight program, configuration management and safety and reliability, among other tasks.



Aerospatiale is also prime contractor for Ariane 5’s main cryogenic stage as well as the two solid booster stages. In 1996, Aerospatiale ranked largest European company in space, and the fifth worldwide — a first for a European company. ●



In the vehicle equipment bay, there are:

- 2 Ni-Cd 25 VR1.6 pyrotechnical batteries;
- 2 Ni-Cd 25 VR1.6 batteries for the safety function;
- 2 silver-zinc 39x14 PNS batteries.

In the upper part of the main cryogenic stage, there are:

- 4 Ni-Cd 25 VR1.6 pyrotechnical batteries;
- 2 Ni-Cd 25 VR1.6 batteries for the safety function;
- 2 silver-zinc 39x14 PNS batteries.

In each solid booster stages, there are:

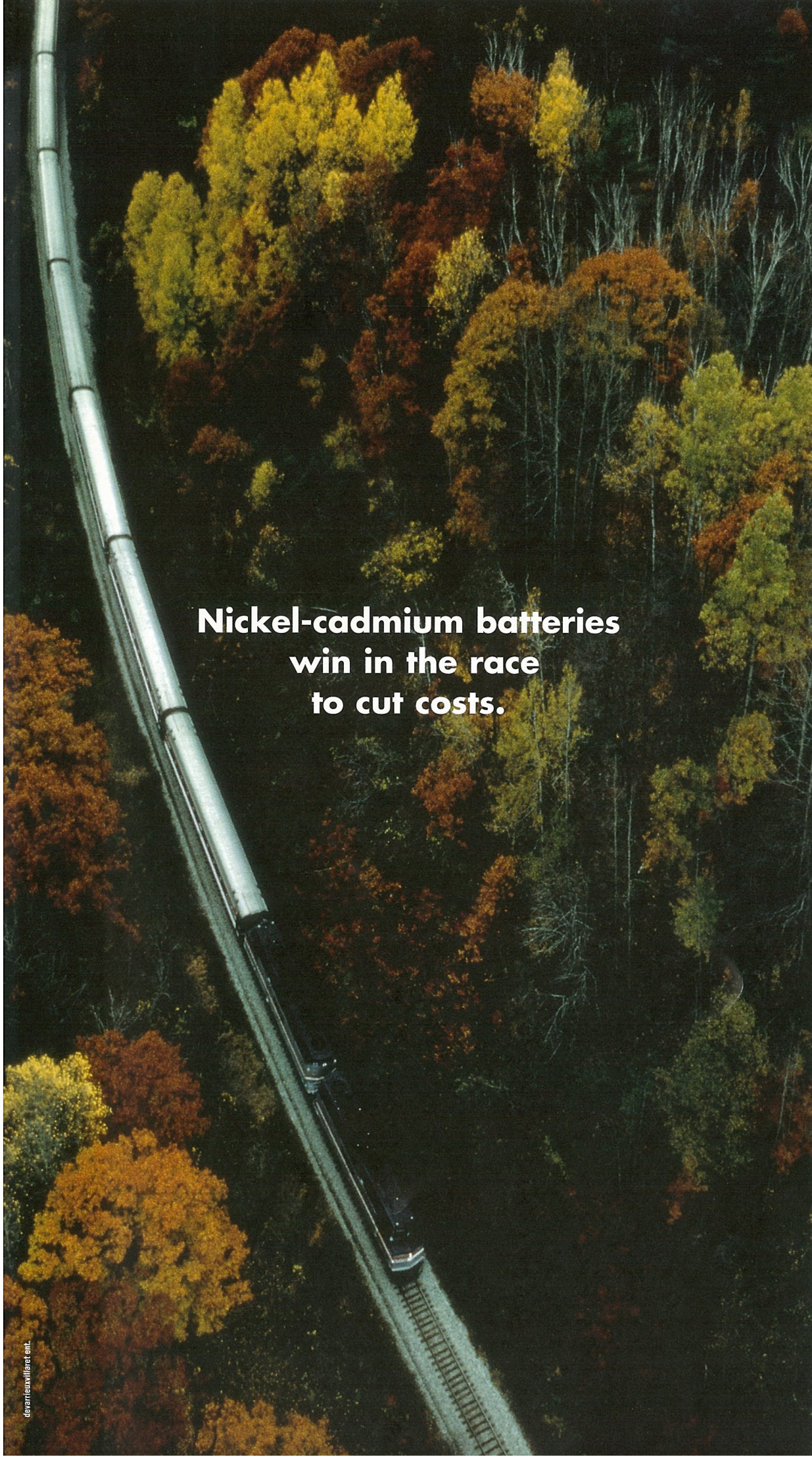
- 2 Ni-Cd 25 VR1.6 batteries for the safety function;
- 2 Ni-Cd 25 VR1.6 batteries to supply energy to the system used for the recuperation of the solid booster stages; this system will be used only with a few launchers;
- 2 Ni-Cd 25 VR1.6 batteries to supply energy to the telemetry system of the solid booster stage.

What do Saft batteries do?

There are two types of Saft batteries onboard the Ariane 5 launcher: nickel cadmium 25VR1.6 batteries and silver zinc 3914PNS batteries. “We chose to stay with nickel-cadmium and silver zinc because they had already proven worthy on Ariane 4,” says Bernard Alquier, the Aerospatiale engineer responsible for power systems

aboard Ariane 5. Depending on the mission, there will be between 14 and 22 Ni-Cd batteries on an Ariane 5 launcher. Six of these perform pyrotechnical functions: sending orders for engine start-up, lift-off and separation of the stages. There are four of these batteries in the upper part of the main cryogenic stage and two in the vehicle equipment bay, where the onboard electronics are located.

The other Ni-Cd batteries, which are located at all stages of the launcher, serve to supply energy to the safety system, which orders the launcher to self-destruct if it detects a malfunctioning — however tiny it may be. Saft silver zinc batteries, however, supply energy to all the electronic equipment, including the onboard computer, the telemetry systems and piloting equipment. ●

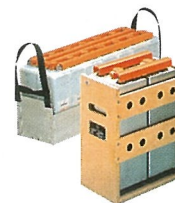


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