

● Number 7 ● Fall 1995

# SAFT

INTERNATIONAL

**Telecoms satellites –  
a global challenge**



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**S A F T**

**SAFT INTERNATIONAL**

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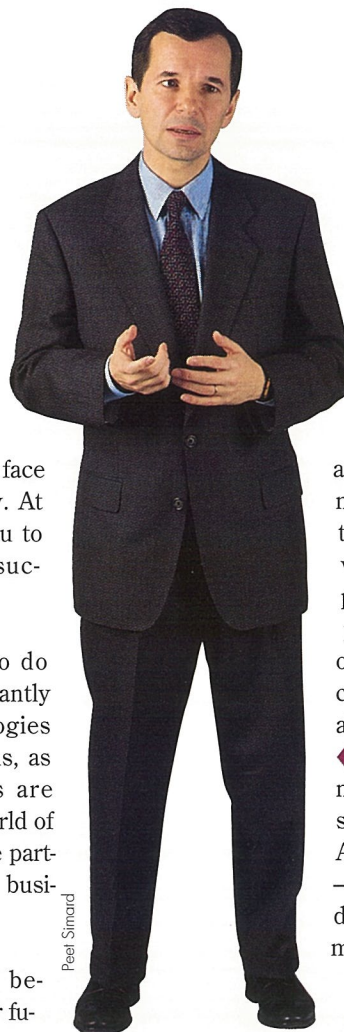
**IN THE CURRENT BUSINESS ENVIRONMENT, YOU NEED A RELIABLE PARTNER YOU CAN COUNT ON.** The world is both fast-changing and highly demanding and in your business you face new challenges every day. At Saft, our job is to help you to meet those challenges successfully.

We are in a position to do this because Saft is constantly anticipating new technologies and evolving market needs, as all the old benchmarks are gradually replaced. In a world of such rapid change, reliable partners are indispensable for business.

You can count on Saft because we've invested in our future – and in yours. Our investments have enabled us to supply you with market-ready products in all our core businesses:

◆ For portable equipment like phones and laptops, we offer a range of rechargeable battery technologies, including the latest in powerful, lighter-weight lithium-ion batteries. And our nickel cadmium and metal-hydride cells remain highly competitive for each of their applications.

◆ New Saft plants are beginning large-scale manufacture of batteries for electric vehi-



Peeet Simard

cles. This innovation in transportation, which is featured elsewhere in this issue, will revolutionize the experience of city-dwellers.

◆ Major growth in traditional and new-technology telecommunications – from “PBX” office systems to wireless mobile networks – requires infrastructure power solutions too. Saft is emphasizing an international family of power systems, easily able to cross borders and perform reliably.

◆ In space, our new battery technologies for satellites feature a substantial reduction in weight. As a result, payload applications – in science, telecommunications, defense or other areas – can be more reliable and “space-safe.”

Saft's investments in these four areas, among others, demonstrate our commitment to putting our customers first. With your support, and encouraged by your satisfaction, we at Saft will continue to use our worldwide capabilities to serve you better. Our parent company, Alcatel Alsthom, recognizes Saft as a single business within its \$33.5 bn business world. For you, our customers, this means that meeting your needs is our first and main priority. You can count on us!

**DENYS GOUNOT**  
CHAIRMAN AND CEO

Cover: CNES



# Telecoms satellite batteries – a global challenge

Battery technologies are evolving  
to meet new satellite needs



**Civil  
telecommunications  
is the fastest  
growing satellite  
application**

**E**ach year during the 1990s an average of 90 satellites (excluding micro-satellites) have been or will be launched into Earth orbit. Whether in geosynchronous (GEO) or low earth orbit (LEO), and whether their primary function is military reconnaissance, scientific research, meteorological observation, broadcasting or telecommunications, these have one feature

in common: they rely on batteries for power when their solar panels cannot function during the eclipse period. This annual launch figure represents sales of some 4000 cells per year, corresponding to about 180 batteries made up of individual cells. Though the actual numbers of cells/batteries sold are small compared to terrestrial commercial markets, their high performances and



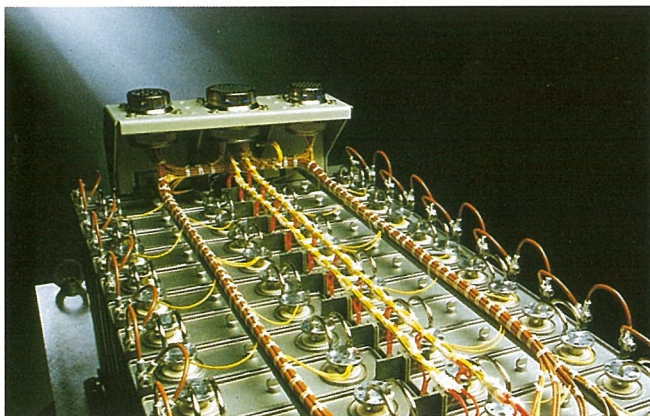
**Saft NiH<sub>2</sub> batteries have been  
selected on 19 telecoms satellites**



PIX/SA

**The 66-satellite Iridium is currently under production and will be launched within the next three to five years**

**Saft nickel cadmium batteries were installed in the first French and European satellites**



DR

the importance of their role in satellite systems make this a challenging business.

Saft's track record as a leading supplier of advanced battery technology to the space industry includes 30 years experience and more than 300 launches. By constantly improving the quality of its products, the company is making a significant contribution to this ultra-specialized business.

**PICTURE FOR THE DECADE**

By far the fastest growing type of satellite application is civil telecommunications comprising direct broadcasting, fixed satellite communications and mobile communications. The exact picture for the remainder of the decade will depend on a number of factors. The positive factors include the growth of telecommunication services in the Asia Pacific region (driven by sustained GNP growth rates in the 7% - 13% range) and the emergence of LEO and GEO mobile satellite systems.

Another potentially high growth application for developing nations is for high-power direct-to-home television. Latin America, for instance, is expected to get at least three new competing satellite television systems in the next couple of years. Yet another application is for high-speed, high-capacity computer networking and the provision of data links.

On the other hand, satellites will have to face competition from fiber optic cables, and with new GEO satellites being designed to last longer, fewer launches can be expected after 1998. Growth is therefore expected to be more marked in the low earth orbit satellite segment, for the so called big LEOs or GEO constellations which involve a high number of satellites for each system. Use of mobile phone networks, even across nation-



Piet Simard

al borders, is driving the demand for LEO satellite-based systems, which offer an economical way for developing nations to acquire telecommunications capabilities.

Global communication systems involving large numbers of satellites, such as the 66 satellite Iridium and the 48 satellite Globalstar constellations, are currently under production, with launch dates indicated within the next three to five years. Other newcomers such as Inmarsat P or Odyssey are also expected, and will provide global mobile telephone services for voice and data communications.

Another even more radical project is the Teledesic system backed by Bill Gates, with a planned 840 little LEOs in 700 km orbit, to provide high capacity data, video and voice services worldwide, using receivers and small antennas installed in homes and businesses. If Teledesic takes off – and some engineers predict the number of satellites in orbit at any one time could top 1000 – the growth in satellite construction and launch-





**An average of 90 satellites are launched into earth orbit every year**

of the satellite. For GEO satellites, planned operational lifetime is steadily increasing (more than 15 years in orbit), along with size and capacity. More than half the satellites scheduled for launch after 1996 will have a mass between 2400 Kg and 3600 Kg, with corresponding power requirements of 4 to 8 kw.

With its large capacity range and high energy density, Nickel Hydrogen is now the preferred technology for GEO systems. The demand for higher capacity cells (from 120 to 200 Ah) is expected to grow to reach about 20% of the total number of cells used on GEO telecommunication satellites.

For LEO constellations, the required battery capacity is in the range of 30 to 60 Ah. Here, production rates as well as costs are the driving parameters when selecting a battery supplier.

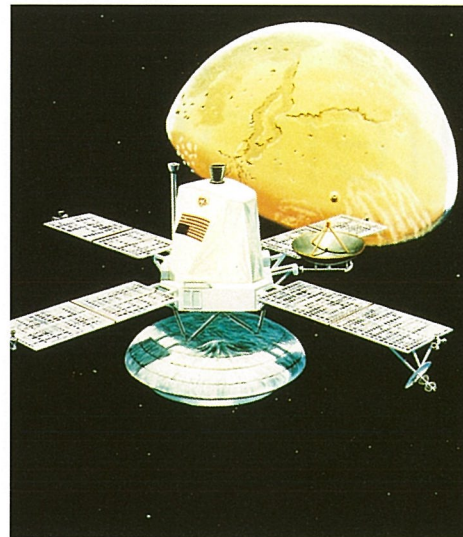
**SAFT'S SPACE OFFERING**

Prior to the development of nickel hydrogen (NiH<sub>2</sub>), Saft's nickel cadmium (Ni-Cd) cell technology played an important role in space applications and continues to do so. Saft Ni-Cd batteries were installed in the first French and European satellites, and are still used in many LEO satellites and GEO telecom satellites such as Skynet and the recently launched Indian satellite INSAT. These batteries equip more than 50 satellites still in orbit today.

Saft nickel hydrogen (NiH<sub>2</sub>) products have been selected on 19 telecommunication satellites since 1987, with launches scheduled up to 1997. These include among others, the Japanese satellites, Superbird and Nsar, satellites ordered by Intelsat: Intelsat 7 and 7A, the Italian Italsat, the Israeli AMOS, the Indonesian Indostar and one satellite for Thailand Thaicomsat.

**SAFT - INCREASING ITS MARKET SHARE**

In the foreseeable future, American manufacturers will continue to dominate the satellite construction market, with roughly



Pix/SA

80% of satellite builders located in the US.

European competitiveness in the satellite industry may well be enhanced through the coming merger of two of the satellite divisions of France's Aerospatiale and Germany's Daimler-Benz Aerospace. The new company, tentatively named European Space Industries (ESI), to be headquartered in Munich, will be directly in competition with the Franco-British satellite builder Matra Marconi.

Across the Atlantic, the American big three satellite manufacturers, Hughes, Lockheed Martin and Loral, will be equally committed to maintaining their existing two-thirds market share. The stakes are clearly enormous, not only for satellite constructors, but for telecom service providers, launch vehicle operators, and other contributors - Saft included - to the communications explosion of the dawning millenium.

With its extensive experience in the telecoms satellite field and dedicated product offering, Saft is well positioned to strengthen its position in the US market, while consolidating its share of the European market.

Building on its reputation for original R&D, Saft is pursuing its NiH<sub>2</sub> product optimization and is currently working on reducing cost and delivery time. At the same time the lithium technology being developed by Saft for electric vehicles and portable batteries will benefit next-generation GEO (and possibly LEO) satellites. With its greatly decreased weight and with specific energy 2-3 times higher than NiH<sub>2</sub>, lithium technology is now considered a very promising technology for future telecommunications satellites. ■

es could be dramatic. In today's rapidly evolving market place, battery manufacturers must be ready to respond to the quick pace of change.

Many spacecraft manufacturers are eyeing with interest the potential demand in countries that lack a terrestrial communications infrastructure. Provision of basic telephone services, currently minimal in many Asian and African countries, will be a mainstay for space communications development, especially in the Asia/Pacific region.

**ADAPTING TO SPACE NEEDS**

Batteries used on satellites provide the spacecraft with power needed to operate all its instruments when sunlight is blocked by the earth. The batteries are then recharged during the non-eclipse period when sunlight is falling on the satellite's solar panels. Satellite lifetime is largely a function of battery lifetime: the greater the number of charge/ discharge cycles the battery can support, the longer the lifetime



# Trends in telecoms

**A shift from public to multiple, private ownership has revolutionized the telecoms network industry**

**Saft provides energy solutions in the new telecoms environment**



DR

**N**ot only does the telecommunications explosion mean increased sales (from less than 30% of total Power Systems sales in 1994 to a projected 50% by the end of 1996), but major changes in the market have led Saft to develop a comprehensive strategy aimed at becoming one of a handful of world leaders supplying energy to national and international telecom networks. With growing internationalization of telecom networks, Saft is committed to a dual track national/international approach: proximity to national users is ensured through localised production plants (e.g. in France, Spain, Germany, Singapore, Canada, Brazil, Italy...), while its international presence is based on development centres in Europe and North America.

## ■ PERFORMANCE IS A MUST

Another key trend concerns deregulation and privatisation. Instead of a single public authority owning and operating each national network, there are increasingly two or more privately owned operators providing services in each country. This shift from public to multiple private ownership, which began about three years ago and will continue up to the year 2000, typically results in a distinction between network builders and operators. The energy systems manufacturer now tends to supply the network builder – Saft's customers include Nokia, Ericsson, Alcatel, etc. – rather than private operators (or, as was previously the case, the public authority operator).

The trend is accentuated by a concurrent shift away from fixed copper cable networks towards mobile radio, satellite and multimedia systems. Operators of these new networks think and behave very differently from the old public authorities. They are looking for recognized product performance, quality and exportability at lower prices, with an increased emphasis on service and innova-

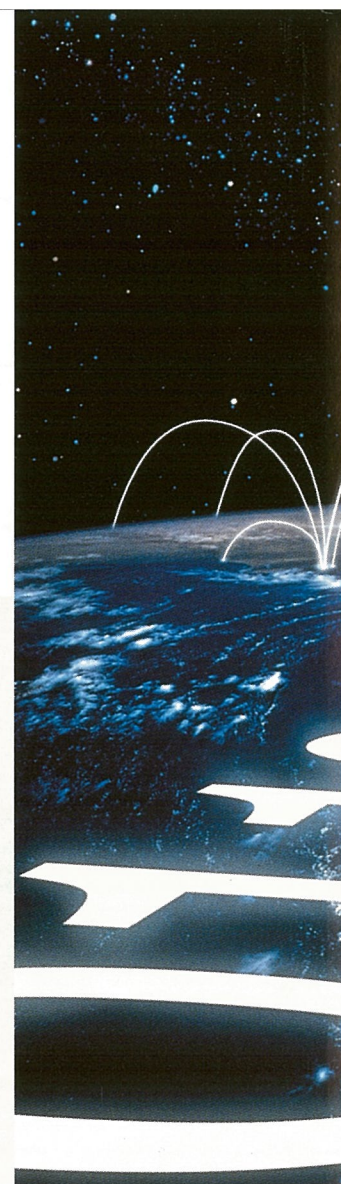
tion from their suppliers. In response to these trends Saft offers a continuously updated product range at competitive prices within an international perspective, as well as a complete service from initial consultancy to staff training and operational assistance.

Another consequence of the trend towards diversification is a relative decrease in demand for switching and line transmission equipment for national fixed networks and infrastructure, and increased demand for equipment for microwave links (rural networks and backup to fixed networks), private cable networks, private branch exchanges (PBX) of new generations, and mobile cellular communications. The telecommunications revolution also extends to intercontinental links, either through satellite coverage or undersea optical fiber cable (where Saft is among the three world leaders in providing power feed equipment).

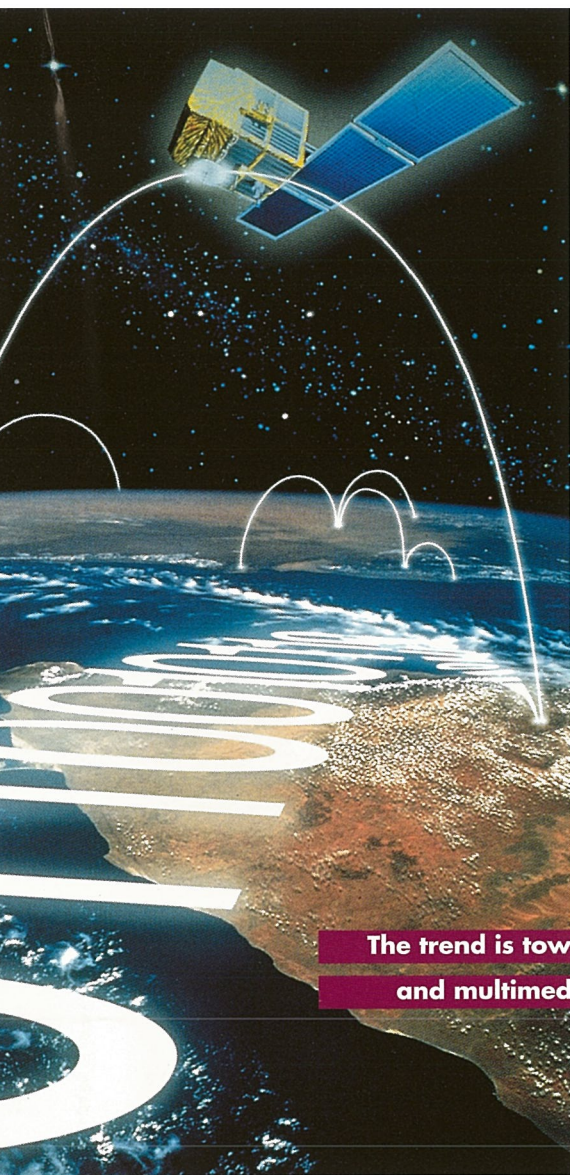
## ■ NEW POWER ENVIRONMENT

Cellular telephony in particular – whether as a supplement to fixed networks (for industrialised countries) or as a cheaper alternative (for developing countries) – involves a move from high energy centralized systems towards low energy decentralized ones. At the same time the shift from analog to computerized digital technology brings a further reduction in energy requirements, placing the emphasis instead on electronic performance.

Through its Power Systems division, Saft







Pettilo/Sipa Image

**The trend is towards satellite  
and multimedia systems**

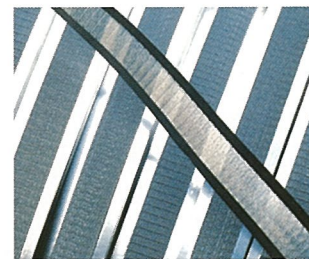
provides energy solutions to all these applications within the new telecommunications environment. With telecom networks requiring a DC power supply, as well as needing to function independently of the electric grid, Saft's range of energy supply systems ensure that high quality electric power for these highly sensitive applications is maintained at all times. Equipment includes rectifiers (for conversion of AC to DC), converters (DC to DC), inverters (DC to AC), UPS (provision of uninterruptible AC power backup), and batteries compatible with the new power environment.

In brief, Saft's product portfolio covers the whole spectrum of the telecom environment in relation to power provision. The many satisfied Saft Power Systems customers among public telecom authorities, equipment manufacturers, and network builders in more than 100 countries include Bell South, Dutch PTT, Telecom Argentina, Société Française de Radiodiffusion, TTNT (Thailand) Beijing Telecom Authority, Telefonica, Deutsche TELEKOM, Telebras Companies, and Quebec Telephone. ■

## I N B R I E F

### POCKET PLATE NI-CDS FOR FINNISH RAIL

Saft Nife OY has signed an annual agreement with Finnish railways for pocket plate nickel cadmium batteries. In addition to the supply of batteries for passenger trains, the contract also provides for the recycling of those batteries which are replaced. This well-proven pocket plate technology is manufactured by Saft Nife in Oskarshamn, Sweden. ■



Peel Simard

### ALL-ELECTRIC BUSES ALL THE RAVE

Electric buses are catching on. Saft, in conjunction with the bus manufacturer APS Systems, has recently been awarded the largest ever all-electric bus contract. Of an order for nine buses, five will go to the Santa Barbara Metropolitan Transit District (whose first Ni-Cd bus was such a success they are now expanding their fleet) and four to Burbank, California. The buses can hold up to 37 passengers and have a digital motor vector drive with a two-string parallel Ni-Cd system. The Ni-Cd batteries can be cycled to as many as 2000 times. ■

### CAR RALLIES GO ELECTRIC

Scandinavia's first rally for electric and hybrid vehicles, organized by Göteborg Energi AB and Oslo Energi, took place from August 1 to 5. Twelve of the twenty-eight competing vehicles were equipped with Saft nickel-cadmium batteries which met up to harsh conditions including frequent periods of acceleration, high temperatures and rapid recharges. In the "prototype" class, the fastest car was a City Bee built by PIVCO, a faithful Norwegian customer of Saft. The rally's success shows the growing interest in this non-polluting form of transport. ■



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### SAFT ACQUIRES UK TELECOMS COMPANY

On August 31, 1995, Saft officially acquired the U.K. telecom power systems company Harmer and Simmons, which is based in London. With more than 65 years of experience in designing, manufacturing and installing DC power supplies and systems to serve major telecommunications users, Harmer and Simmons has a workforce of 350. The company achieved sales of £22.2m in 1994. The acquisition makes Saft the European leader in telecommunications power systems with a 20% market share. ■





# Let your light shine

**Emergency lighting is vital for our safety and peace of mind. Batteries must be 100% reliable**

**E**mergency lighting belongs to that category of products which many people are unaware of, for the simple reason that it rarely needs to be used. Yet emergency lighting units (ELUs) play an essential security role in all manner of environments: hotels, restaurants, cinemas, dancehalls and discos, shops, shopping malls, banks, government offices, places of worship, sports centres and stadiums, museums, libraries, stations, airports, factories, offices – in fact just about any public or workplace environment that depends on electric power for lighting. Only on those infrequent occasions when the standard power source fails or is cut off are ELUs required. Consequently ELUs, and the batteries that feed them, need to be 100% reliable.

#### ■ LOCAL REGULATIONS

The ELU market is distinctive for a number of reasons. First, it is predominantly national in scale rather than European, with each country having different systems, defined – in the absence of any Europe-wide legislation – through local safety regulations. Different standards apply in the UK, France, Spain, Germany and so on. This fragmentation of the market is further accentuated through equipment manufacturers tending to serve only their own national markets.

In terms of growth, this traditional market is relatively slow moving, with growth rates in Europe very much in line with countries' GNP. (On the other hand the Asia-Pacific market is much more buoyant, as a result of major construction programmes under way in these developing countries.) A final point worth mentioning concerns ELU design, which is increasingly concerned with appearance as well as performance, with the older square-box ELU giving way to new, more unobtrusive designs.

Despite variations in equipment, certain requirements remain constant. Batteries must be able to provide lighting for a duration of 1-3 hours; they must be able to function efficiently at the high temperatures (up to 40°C) produced through charging and by their normal position high up in rooms (where the temperature is higher); and they must be able to retain a full charge permanently.

Through its Portable Battery division, Saft provides a range of sealed nickel cadmium (Ni-Cd) batteries for independently manufactured ELUs of all kinds. Sealed Ni-Cd batteries have a number of advantages for these applications, in terms of reliability, long lifetime, and economy of use. (Some new advanced battery technologies are unsuitable for ELU applications – lithium because of its high cost, and nickel metal hydride both because of its relatively high cost and its charging retention.)

#### ■ LONGER LIFE

In response to the technical requirements of this market Saft engineers have paid particular attention to certain aspects of Ni-Cd technology, in particular the plastic bonded negative electrodes, separators and the battery seal. Saft's sealed Ni-Cd high temperature VT ranges – specially developed for this application – have made it world leader in this segment. With capacity ranging from 0.6 Ah (for small alarms, ELUs in aircraft, etc) up to 7 Ah (for large industrial systems,

**Saft's sealed Ni-Cd high temperature VT range**



Peel Simard





**Emergency lighting plays a vital role in public places like cinemas**



Joanne Deleporte

metros, etc), the Saft VT portable battery range ensures good charge efficiency and longer lifetime at high temperatures as well as high charge retention. The 7 products in the VT range, including the recently added VTC 2000, are made at Saft's production facilities at Nersac (France) and Tijuana (Mexico) and are marketed primarily in Europe, but also in the US, Japan and elsewhere.

Looking to the future, one interesting development concerns combined voice and emergency lighting systems. As well as providing lighting when the main power supply fails, these also give a voice message indicating what to do in the emergency situation. In Japan ELUs already have this additional facility, and in France a similar system exists with fire alarms for offices and factories. This market segment, where Saft batteries are already present, is likely to increase in importance over the coming years. ■

## I N B R I E F

### SAFT GAINS A Foothold IN THE EAST

The Czech firm Ferak, specialist in the production of nickel-cadmium batteries, has been acquired by Saft. With a 1994 turnover of some \$7m, Ferak has a 250-strong team. It supplies NiCd batteries used in rail transportation, mining and industry. With this acquisition, Saft is penetrating the industrial battery market in Central and Eastern Europe, up to now closed to Western products. Ferak holds a 35% share of the region's market and virtually 100% of its home Czech market. ■



### FIVE NAVIES CHOOSE SAFT

Saft is favorite among navies worldwide. Five navies, three in Europe, and two in South America, have picked Saft batteries for torpedo power amounting to an order worth \$2m. Despite a severe decline in the torpedo propulsion batteries market over the last five years, in part due to the end of the Cold War, this segment is now showing sure signs of growth. Navies are replacing obsolete batteries to maintain their operational capabilities. Also, prime contractors are negotiating contracts for the armament of new submarines. An exciting business opportunity for Saft Advanced Battery Group. ■

### GROWING MARKET SHARE

With a current French market penetration of 29%, Saft's security systems division (emergency lighting and fire alarms) is well on its way to becoming the market leader in security systems distribution. Saft has a two-pronged strategy. It deals directly with specifiers so that Saft products are stipulated in project specifications. Secondly, due to close monitoring of customer needs and market trends, Saft has the know-how to adapt to market demands, producing increasingly intelligent and complex integrated systems. Currently under development are self-controlling security blocks which signal the slightest fault to a central system in real time. ■

### NEW NI-MH RANGE

Saft now offers nickel metal hydride technology in a new cylindrical VH AA range designed specifically for the rapidly expanding market that prefers cylindrical Ni-MH cells in cordless telecommunications and computers. The VH AA range weighs only 25 grams, supplies a minimum capacity of 1.10 Ah, and lasts for over 500 cycles. It is manufactured at Saft's state-of-the-art facility in Nersac, France. In addition, Saft offers a complete range of prismatic Ni-MH products (3 sizes) for OEMs which can upgrade a portable phone's talk time by as much as 45%. Saft will soon launch VH 4/5 A and more cell sizes are on their way to complete the VH range. ■



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# On the right track

**The U.S. rail industry is a fragmented one – authorities require different specifications for similar projects**

**S**aft is the supplier to a worldwide \$180 million rail battery industry (excluding China and the CIS) which is set to expand significantly by the year 2000. In Europe alone, the potential high speed train market should increase by 93% between 1998 and 2002, with concentration in France, Germany, Italy and Spain.

Saft Nife nickel-cadmium batteries represent 85% of the railway battery market on both sides of the Atlantic. In the U.S., Saft must respond to equally stringent if different safety specifications to those that exist in Europe, as well as to the demands of a passenger railway market controlled by market forces, rather than by the needs of publicly financed transport authorities.

#### ■ REQUIREMENTS VARY

"There is a great deal of pressure on costs here. They won't install anything if it doesn't make money," explained Ole Vigerstol, Saft national sales manager for the industrial batteries division in the U.S., based in Valdosta, Georgia.

The overall U.S. railway market represents approximately \$60 million per annum, compared to the European total of around \$50 million.

Manufactured in Bordeaux, France, and Oskarshamn, Sweden, Saft's basic railway product, the SRT, SRX and SRM series nickel cadmium battery, consists of vented rechargeable cells based on the nickel-cadmium couple of nickel hydroxide for the positive electrode and cadmium oxide for the negative. The batteries have an 8-15 year life span in rail and transit operations and the absence of electrolyte reaction prevents both long-term corrosion and "sudden death" on the job. They require little maintenance and need only be topped up once a year.

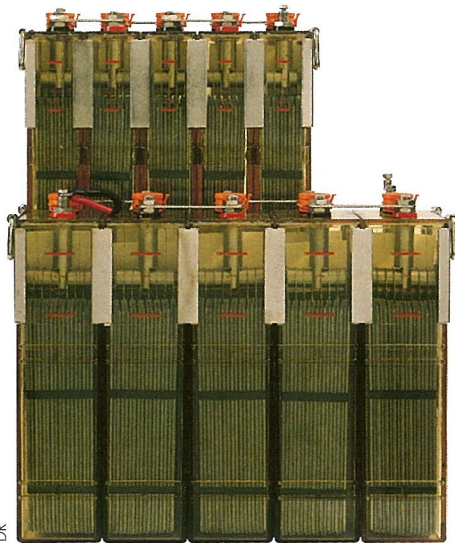
In America Saft is obliged to work in a fragmented market, which, especially in



areas such as metropolitan transit, often requires different specifications for similar projects. "Americans, frustrated with urban congestion, are becoming more and more interested in efficient means of mass transit, but there is still little coordination," Vigerstol said. In the San Francisco Bay area alone, Saft supplies five different regional transport authorities, each with varying requirements. "The Paris transit authority is much more coordinated," he said. "We do a lot more legwork here."

"Another major transatlantic difference is that Europeans call for steel containers," said Philippe Ulrich, Saft U.S. Sales and Marketing director, "while in the U.S. standards and safety requirements stipulate flame retardant battery containers which are also transparent." Saft was quick to respond to new U.S. standards. "As a result, we're in a strong position, with 85% of the market share in rail transit last year," said Ulrich.

Unlike the Europeans, and notably the French, who are genuine pioneers in the development of such high-speed trains as the Paris to London Eurostar, Americans have been more timid in their modern train construction. "America has some catching up to do in the area of subways and high speed trains," said Ulrich.



**Saft's Ni-Cd batteries have an 8-15 year life span in rail operations**





Image Bank

**Americans are increasingly interested in efficient means of mass transit.**

But over the past decade things have begun to change. American firms such as Morrison and Knudsen and Canadians such as Bombardier have recently entered the high-speed race with Saft as a major player in the game. For example, as a subcontractor to Bombardier, Saft plans to supply batteries for emergency backup service in high speed trains which should soon be operating along the busy Northeast corridor route between Boston and Washington DC.

**■ MORE RAIL PLEASE**

On board car batteries serve three types of passenger vehicles – heavy rail cars (subways), light rail vehicles (trams) and push-pull or commuter service cars. The batteries support such in-car functions as emergency lighting, public address systems and door operations. As in Europe, Saft also provides signaling support to freight trains.

The States has seen a push from city administrations to introduce more rail transit facilities. This has led to upgrading and new investment in networks around the country. Having kept abreast of changes in standard specifications, Saft has put itself in a strong position to meet further expansion in the U.S. market. ■



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**THAI COUP**

Facing down heavy competition, Saft Nife Power Systems Singapore has won a major order from Thai Oil. One of the largest refineries in Thailand, Thai Oil is state-owned and in partnership with the Shell Group. The \$1.2m order was for 13 units of 5-45 Kva UPS and rectifiers, complete with nickel cadmium batteries. The UPS and chargers were manufactured in Singapore and the Ni-Cd batteries came from Saft Nife in Sweden. ■



**QUALITY UPDATE**

The Power Batteries division in Poitiers, France, has received ISO 9001 quality accreditation following a series of audits by AFAQ (French Association for Quality Assurance). ♦ Latin American quality was also confirmed for Power Electronics as new ISO 9000 certification was earned by Nife Brasil Sistemas Electricos Ltda's Sao Paulo plant. ♦ Portable Battery's Tijuana plant, which won its ISO 9001 certification for its entire production and sales operations, also set customer shipment records in March (\$10m) and June (over \$11m) with more than 90% shipments on time. ♦ A quality award was also recently awarded to Saft Nife in Tours, France, by SNCF (French national railways). ♦ Last but not least, the Portable Battery Division at Nersac and a section of St Yrieix have also received ISO 9001 quality certification. ■

**RESEARCH BREAKTHROUGH**

A significant breakthrough in the field of industrial supercapacitors was recently made by Saft and Alcatel Alsthom Recherche. Based on studies carried out at Marcoussis (France), the new technology combines carbon with an organic electrolyte and is the only method known to date to build cost-effective supercapacitors suitable for industrial applications. The system has high performance with a capacitance of 1800 farads (compared with a few millifarads for usual capacitors), a service voltage of 3 V, a volume of 0,6 liters and a maximum discharge current of 400 A. ■



Cancault

**SAFT POWERS INDOSTAR SATELLITE**

Saft has signed a contract with CTA Inc., the U.S. aerospace technology firm, to supply the electric power batteries aboard the Indonesian Indostar 1 satellite. Drawing on its long experience in cell design and battery assembly operations, Saft will be supplying two 22-cell 52 Ah nickel hydrogen AN batteries for the light-weight geostationary satellite. The performance standards and ever-higher energy densities of Saft's leading-edge products in this field have attracted several orders from main American satellite manufacturers, the latest being Indostar. ■



# Manufacturing batter

**Saft is the first to put batteries for all-electric vehicles into large-scale industrial production. A vote of confidence in a burgeoning market**

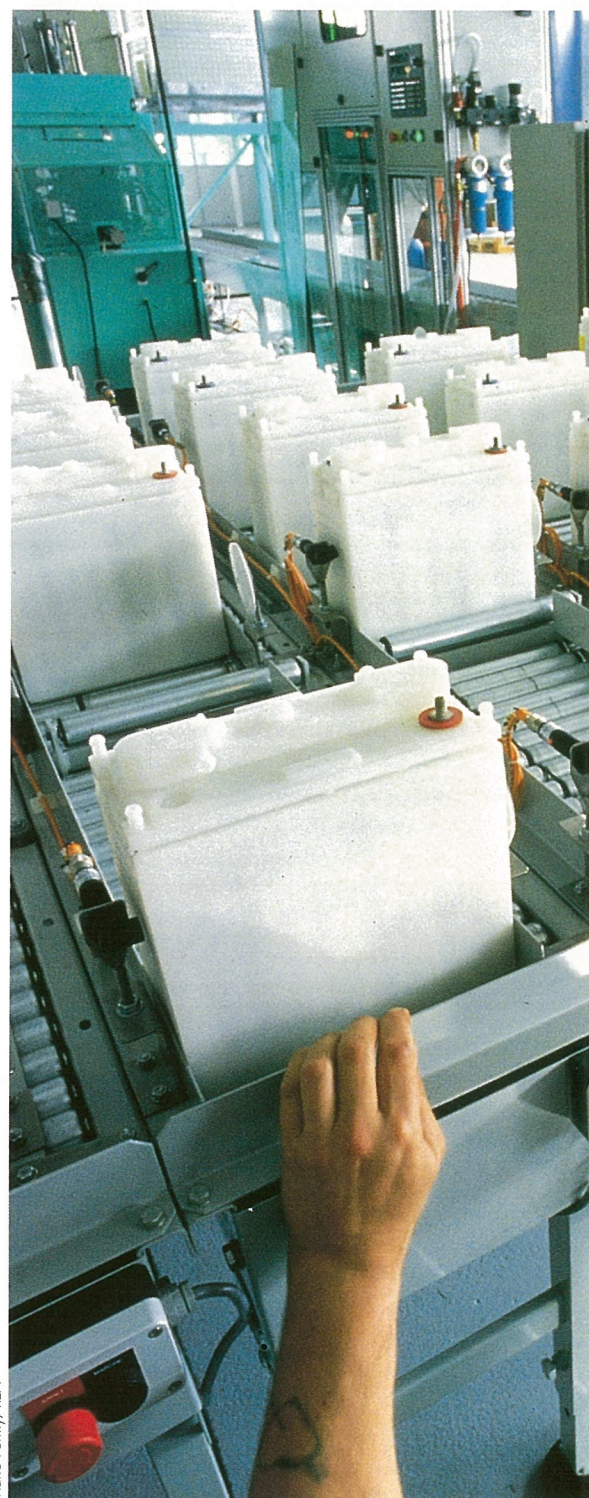
**T**he year 1995 is a watershed in the history of the all-electric vehicle (EV). This year sees its official commercial launch by such leading car manufacturers as Citroën, Peugeot, Renault, all of whom expect to capture a significant market share over the coming years. Such advances have come about as a result of the close partnership between car manufacturers and suppliers among them Saft, whose Ni-Cd STM 5100 MR and MRE monoblocks have now gone into industrial production.

#### — A NEW SCENARIO

Attitudes towards electric vehicles are fast changing. It has long been accepted that, in principle, the zero emission all-electric vehicle represents a pollution free, noise free alternative to conventional thermal vehicles for urban use. But limitations of range and performance, together with high cost, seemed to limit their commercial prospects, however attractive they might be environmentally. However, this is no longer the case. All-electric vehicles now offer an impressive performance profile for urban conditions, thanks in great part to the ongoing development of Ni-Cd battery technology which Saft has pioneered.

As well as leading French carmakers who are currently launching all-electric versions of production model cars, specialist manufacturers are also now developing a range of new electric vehicle designs specifically conceived and built around their battery and all-electric technology. The signs are that the era of the all-electric vehicle has well and truly arrived.

Essentially city cars, with a range suited to meet everyday in-town and commuting needs, all-electric cars should from now on constitute a steadily expanding portion of the total car market. Saft is the first to put all-electric vehicle batteries into industrial production, and its dedicated STM batteries are already being used in a range of EVs



Mario Formy/REA



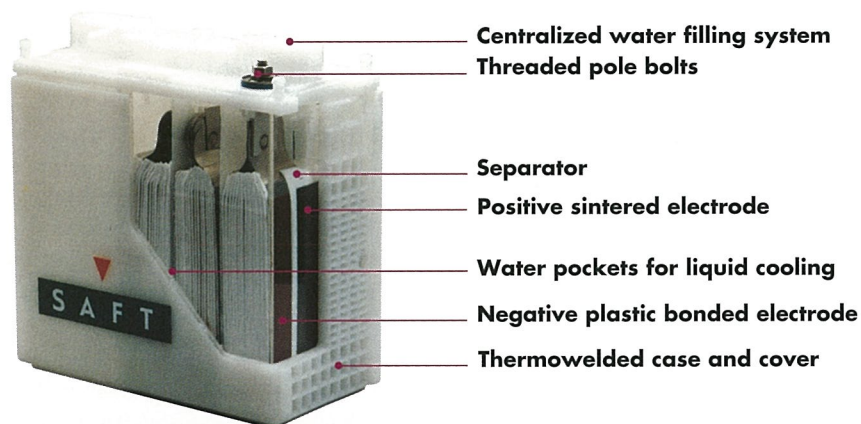
Peel Simcard

**A customized monoblock assembly - an example of Saft's know-how**



# ies for all-electric vehicles

Saft's mastery of Ni-Cd battery technology has made it world leader in this field



**STM 5100 MRE 6V module, consisting of 5 electrode stacks assembled into a compact monoblock design**

from leading car manufacturers as well as specialist EV producers. The role played by Saft in serving this market and in helping to shape the emerging new transport culture is therefore a vital one.

Though not directly the concern of this article, combined electric/thermal vehicles are also making their contribution to the changing transport scene. These are of two kinds: hybrid, where a thermal engine draws additional power as needed from a battery; and bimodal, where the vehicle is equipped with both electric and thermal engines, and uses either one or the other as required. Saft's STH series, and other batteries, have been specially developed to meet the needs of vehicles of this type.

## **— ALL-ELECTRIC VEHICLE BATTERY AND DRIVE TRAIN**

The arrival of the commercially competitive EV has been possible in large part due to the development of a battery technology that can provide the necessary range and performance. The only existing battery couple capable of meeting the various technical and commercial criteria demanded by electric vehicle manufacturers is nickel cadmium. Saft's mastery of NiCd battery technology has established it as the world leader in this field.

The sole energy source of an all-electric vehicle is its battery. In Saft-equipped EV versions of standard car models – such as the Renault Clio, the Peugeot 106 and the Citroën AX – these are usually placed under the bonnet and the rear seat. However, all-electric vehicles that have been specifically designed as such – e.g. the Ion from PSA or the City Bee from PIVCO (Norwegian car manufacturer), which also use Saft batteries – tend to have the battery built as a single assembly on the vehicle underbody, thereby optimizing the weight distribution.

With the battery as the sole energy source for EVs, many of the mechanical and control systems have been reconsidered in a new light. The drive train consists basically of an electric motor powered by the battery, which creates the torque-generating magnetic field that turns the wheels. (In some EV models the motor uses DC, in others DC converted into AC – though this makes no difference to the battery provision). In addition, a converter is required to regulate the flow of current to the motor, thereby modifying the vehicles speed. This also functions to convert kinetic energy, that would otherwise be lost through braking, back into electrical energy (in towns up approximately 15% of the total energy produced), which is thus



# Manufacturing batteries for all-electric vehicles

## TEN KEY ADVANTAGES OF SAFT NI-CD STM BATTERIES FOR ALL-ELECTRIC VEHICLES

- ▶ High range per charge, up to 80-100 km of urban driving, according to conditions.
- ▶ Specific power of 200 W/kg at 80% depth of discharge (DOD) gives good starting, acceleration and incline ascent.
- ▶ Relatively light and compact, with specific energy of 55 Wh/kg and energy density of 100 Wh/dm<sup>3</sup>.
- ▶ Battery lifetime equals that of the car – 2000 cycles at 80% DOD, nearly 100,000 cycles at 10% DOD, representing a 7-10 year lifetime or between 100,000 and 200,000 km.
- ▶ Virtually immune to mechanical or electrical abuse.
- ▶ Fast charging - up to 80% capacity in half an hour, full recharge in six hours.
- ▶ Operational over a wide temperature range: -30°C to +50°C (-22°F to +122°F).
- ▶ Easily carried out, low maintenance requirements.
- ▶ Lowest passenger per mile cost of any couple on the market, despite an initial higher purchase cost.
- ▶ Environmentally safe, with 99.96% recyclability.

The Pivco has been specifically designed around its battery and all-electric technology

available for battery recharging.

Saft batteries for EVs are made from customized assemblies of monoblocks, which themselves consist of five 1.2V cells connected in series. A typical 20 monoblock Saft battery thus provides 6V per monoblock, or 120 V in total.

Electric vehicles also require an electronic on-board computer to monitor the functioning of the system and battery. Displays show the amount of energy remaining in the battery. This “econometer” – designed specifically for the all-electric vehicle – is useful for keeping energy consumption to a minimum and thereby extending the range of the vehicle. During battery recharge, information is displayed on the state of charge and the time required to complete it. Recharging in addition requires that a charger be installed in the EV. Batteries are recharged by connection to a domestic power point or other source, such as dedicated recharging stations in cities.

### — WORKING WITH CARMAKERS TO PERFECT BATTERY TECHNOLOGY

Saft is committed to working in close

partnership with car manufacturers, and, ever since the first trials, has designed batteries in conjunction with the entire design of the vehicle.

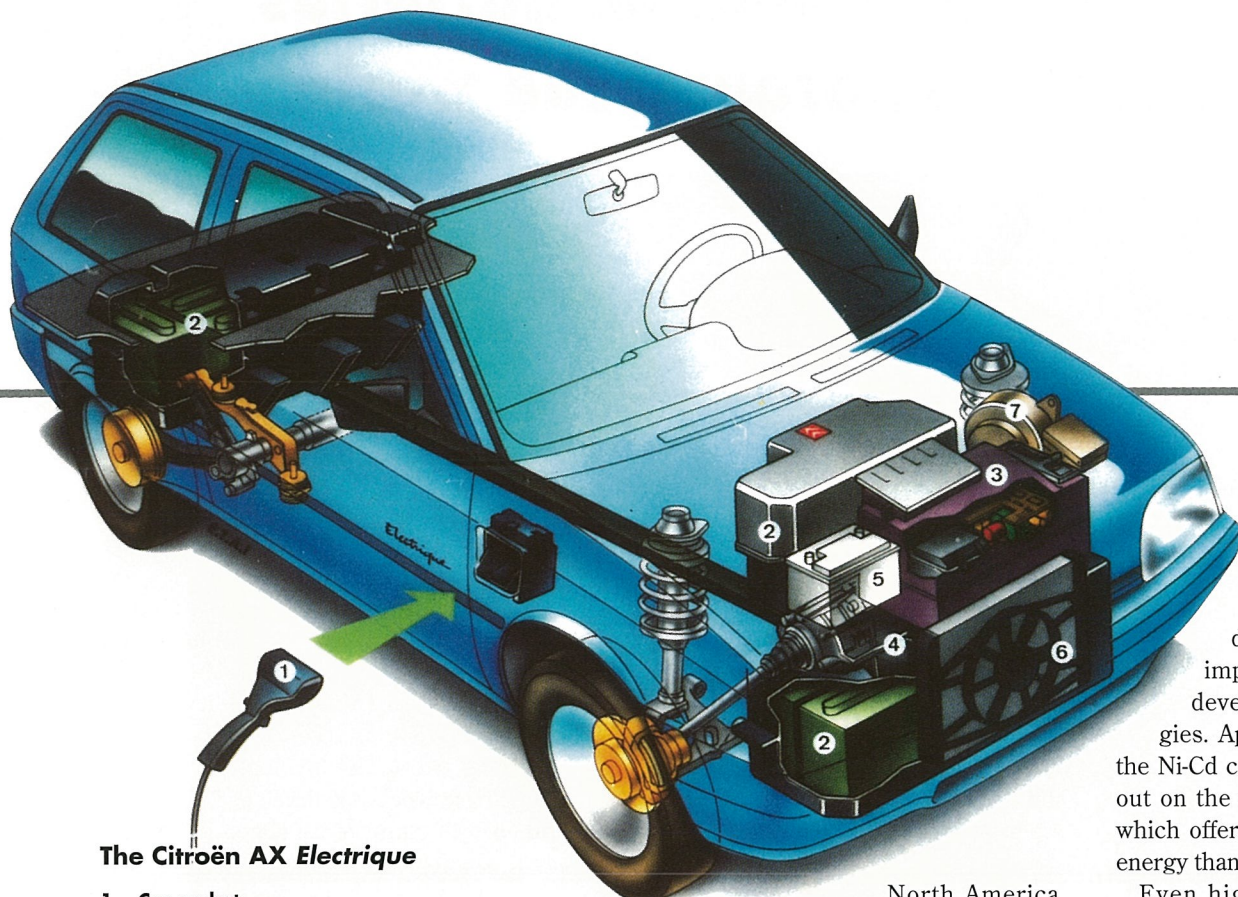
Saft’s state-of-the-art, ultra-low maintenance STM 5.100 MRE monoblock, now entering industrial production, is the latest development of the monoblock technology which the company has been perfecting over the years. The 6 volt, 100 Ah, 5.100 MRE monoblock was developed in collaboration with carmakers Peugeot, PSA Peugeot, Citroën and Renault (through their joint PSA electric vehicle programme), with backing from the French Ministry of Industry. This advanced product brings further savings in size, incorporates a hydraulic cooling system, needs one tenth of the maintenance and yet has 10% greater capacity than earlier prototypes.

The development of the STM 5.100 MRE monoblock involved a long process of technical innovation and improvement. The monoblock design itself brought further volume reduction and the thermal management requirement was solved by designing a cooling hydraulic circuit with a distribu-



Pivco





**The Citroën AX Electric**

- 1 Car socket
- 2 Saft nickel cadmium traction battery
- 3 Electronic control system
- 4 Motor and transmission
- 5 Auxiliary battery
- 6 Battery cooling
- 7 Motor cooling

tion water jacket having a single entry and exit point for each block. The maintenance checks are carried out once every 10,000 km, and can be quickly implemented at specialist garages.

Also, to compensate for the natural tendency of the electrodes to swell during cycling, a special casing with convex curved walls was designed. These walls check and resist the expanding force (of up to 150 kg per monoblock face).

With a dedicated development programme in close collaboration with car manufacturers, Saft has successfully met the challenge of providing a reliable, compact, low maintenance power source for all-electric vehicles. The numerous advantages of Saft's Ni-Cd STM batteries are specified on the previous page.

**— ELECTRIC VEHICLES UP AND RUNNING**

The viability of electric vehicles is no longer in question as an alternative means of private and public transport in and around cities. A number of schemes are already in operation in Europe and

North America, including all-electric buses in cities such as Tours, France, Sacramento and Santa Barbara in California and bimodal/ hybrid buses in San Francisco, New York, Milan and Stockholm – all of which make use of Saft batteries.

Other cities are following suit, among them Paris, which will be launching all-electric minibuses in the Montmartre area this autumn. And further, more ambitious schemes are at the planning stage. Most conclusive for the potential of electric cars in cities has been the La Rochelle programme, where a fleet of 50 electric vehicles (46 of them powered by Saft batteries) have successfully been in operation since 1993. Or again, the recent electric car rallies that took place in Sweden (where 12 of the 28 competing cars were supplied with Saft batteries) and Monaco demonstrate that electric vehicles can be exciting as well as practical to drive.

In parallel with these projects and developments, vehicle manufacturers are already preparing for second and third generation models, while manufacturing plants are already in operation and increasingly long production runs of consumer models are scheduled. The European Commission task force on "the car of tomorrow" has earmarked 800 million Ecus for the development of alternatives to established forms of transport, including all-electric vehicles.

**— BATTERY TECHNOLOGY – MOVING AHEAD**

In conjunction with these developments, Saft's research drive continues apace, both to improve existing products and to develop and market new technologies. Apart from constantly improving the Ni-Cd couple, research is being carried out on the use of metal hydride (Ni-MH) which offers in the region of 25-30% more energy than Ni-Cd for the same volume.

Even higher performance levels are potentially attainable with totally new electrochemical couples. Here, Saft is centering its long term research on lithium whose special advantages include high specific energy and output and excellent charge conservation. The cycling capacity of lithium batteries, now possible thanks to recent advances in carbon technology, is also an important consideration. For EV applications one lithium couple – lithium carbon (C-LiMO2) – shows particular promise, especially for its fast recharge potential (30 minutes to one hour). Saft's R&D programme on this couple is being supported by the European Union and the French government.

One very important research goal for Saft is the development of an entirely maintenance-free battery, which would bring obvious benefits to EV applications.

Saft's research is not limited to battery technologies. An ongoing programme is being pursued in collaboration with Thomson, concerning the development of battery management systems. One innovation includes a battery history recording system, particularly useful in cases where vehicles are leased. Now at the prototype stage, such systems should be ready for marketing towards the end of 1996. Public interest is already considerable and will grow as vehicle launches and industrial programs are given news coverage. ■



# Saft Nife nickel-cadmium batteries power railways around the world.



Today's rail transport systems cover a lot of ground and continuously set new standards in performance. Just like Saft Nife nickel-cadmium batteries.

Saft Nife Ni-Cd technology means higher reliability for all rail systems, from mass transit to high-speed trains, from engine starting to lighting and braking.

In fact, Saft Nife traces its roots to rail products and today continues as the industry leader. Take our new SRM range: 20% lighter and smaller for the same power output. Operates from  $-50^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$ . Longer lifetime, better cycling performance and less frequent maintenance for lower life cycle costs. Backed by our ISO 9001 quality

system certification, Saft Nife's global network gives you unrivalled product support, from defining your exact power needs to quick, thorough follow-up. Along with a nickel-cadmium battery recycling program that is established worldwide.

Quite simply, nobody knows Ni-Cd technology like Saft Nife. When we sell you a battery, we're positive it fits your application ... anywhere in the world.

