Industry Perspectives on Markets, Emerging Technology, Research Priorities

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OVERVIEW

- SAFT has a broad portfolio of technology for power and energy storage.
- SAFT has unique capabilities in integration of these technologies into total systems: packaging, thermal management & battery management system.
- SAFT has a world leadership for 'industrial' high energy and high power lithium ion technology.
- SAFT has moved its lithium ion (Li-Ion) technology from the laboratory into 'real' demonstration systems.

Saft Key figures

- Sales: 550 m Euros
- Employees: 4 000
- R&D expenditure: 30 m Euros (5.5% of sales)
- Capital expenditure: 25 m Euros (4.5% of sales)
- Present in 25 countries

Company Achievements

- Since the mid-60's, 2 billion portable cells produced for commercial & military markets (Alkaline, NiCAD®, $LiSO_2$, $LiSOCl_2$). Millions of thermal batteries produced for military markets.
- Since 1979, 100+ satellite launches achieved using Saft batteries (NiH_2)
- Since 1920, Saft has supplied more than 4 billion Ah of industrial batteries (Alkaline)
- The equivalent of 30 round trips to the moon carried out by Saft-powered EVs (NiCAD®, NiMH, LiON®)
- Two out of three planes in the world's skies fly Saft batteries (NiCAD®)
- The largest military battery supplier in the World.
  (non lead-acid)

- Large batteries for industry and transportation applications

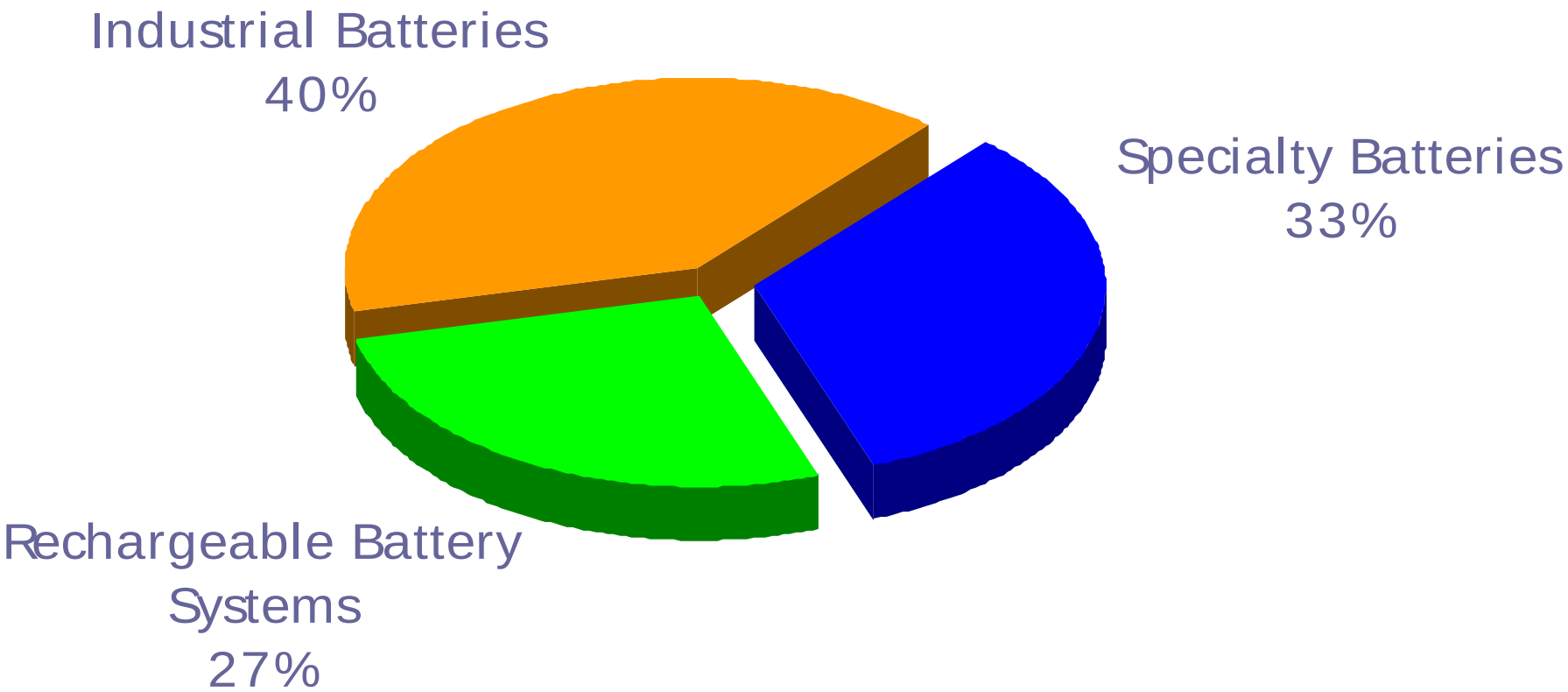
Industrial Battery Group

Specialty Battery Group

- Primary lithium batteries and specialty batteries for space, defense and industrial applications

Rechargeable Battery Systems

- Small batteries for technical and professional applications


Industrial Batteries
40%
Specialty Batteries
33%
Rechargeable Battery
Systems
27%

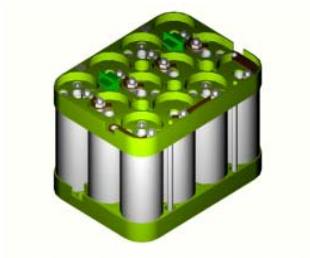
INDUSTRIAL BATTERIES

- NICKEL CADIUM
- NICKEL METAL HYDRIDE
- LITHIUM ION

- Nickel-Cadmium batteries for standby applications
- Nickel-Cadmium batteries for telecom networks
- Nickel-Cadmium batteries for railways and mass-transit

- Nickel-Cadmium batteries for Aircraft batteries

Nickel-Cadmium, Nickel-Metal Hydride, Lithium-ion: the high energy & high power batteries for EVs & HEVs



High Power Li-Ion Battery Pack

For Fuel Cell/Power Assist HEV

- System: 346V, 8 Ah
- Configuration: 96S
- Energy: 2.8 kWh
- Power @ 50% SOC:
  45 kW @ 18 sec pulse @ Rm Temp

  Discharge
- Battery Management System (BMS)
- Thermal Management: Air/Passenger Compartment
- Weight: ~ 64kg

SAFT
Lithium Ion Battery Technology

Distinct Markets

- Military & Space
- Automotive & Transportation
- Commercial:
  - Energy Storage
  - Telecom
  - Stand-By
  - Distributed Generation

SAFT Lithium Ion Battery Technology

- High Energy: the highest energy density 310 Wh/dm^3 and specific energy 150 Wh/kg
- High-Power: the highest power density 2900 W/dm^3 and specific power 1350 W/kg
- Long Cycle life:
  >2,000 cycles for high energy
  > 1,000,000 cycles for high-power
- Calendar life: > 15 years for HEVs
- 100% charge efficiency
- 3.6 V nominal
- Organic electrolyte

Emerging Technology

Distributed Generation - A Demonstration System

480V high power Li-Ion battery / 100 kW SatCon PCS System

- The System comprises the Saft Battery and a 100-kW from SatCon Power conditioning system (PCS) and operates in conjunction with a 60-kW microturbine.
- Two (2) Systems were manufactured and delivered and commissioned at:

  * 1st System: Southern Services Co., Birmingham, Alabama
  * 2nd System: AEP, Columbus, Ohio

480V 100-kW/1-minute
(1.67 kWh) high power
Li-Ion Battery

100-kW SatCon power
conditioning system (PCS)

The Demonstration System

System Functionality

- Distributed Generation (DG), e.g. Microturbine, configured for grid-connected operation Normally in standby mode
- PCS senses loss of ac line and provides seamless transition to ‘island’ operation
- Battery carries critical loads for a period, then microturbine starts up automatically
- Battery also provides or absorbs excess power during load shifts

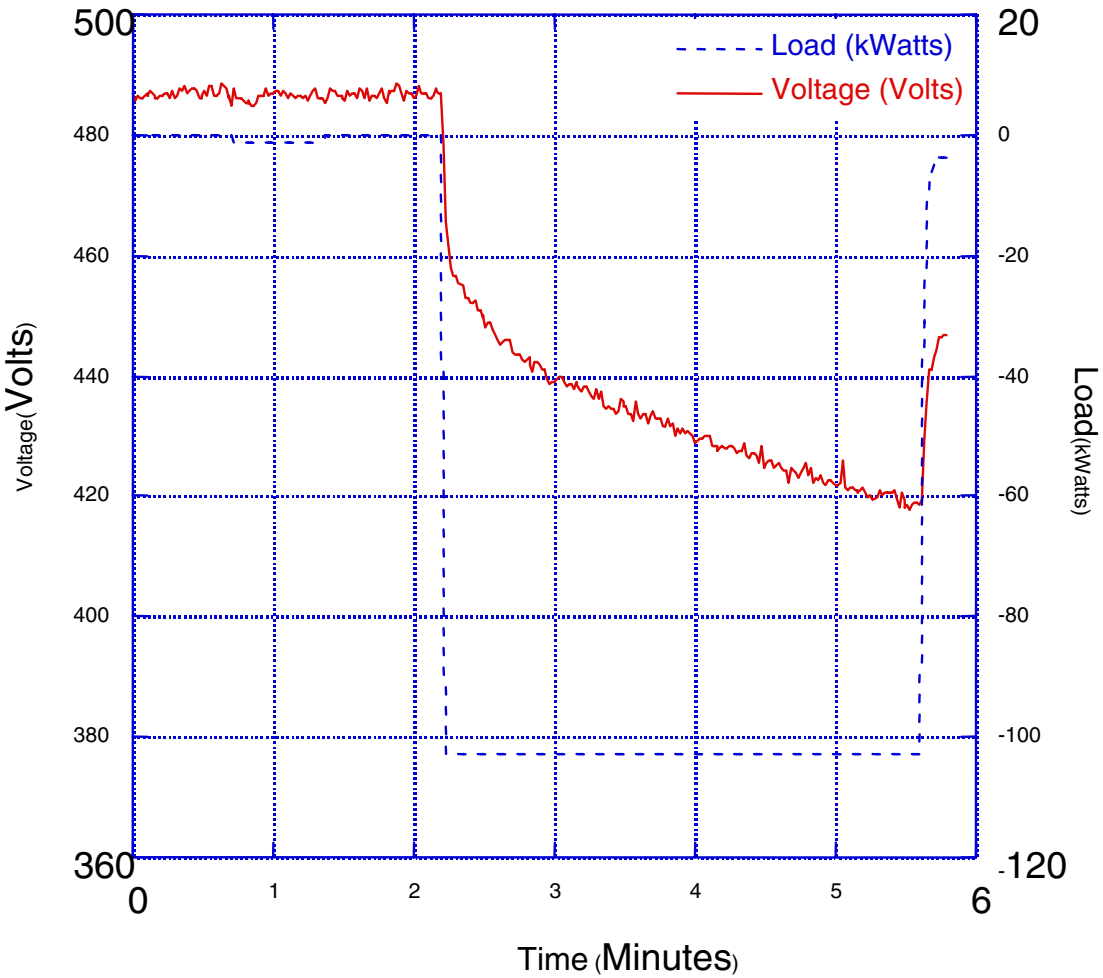
The Demonstration System
System Overview

- Nominal 480V high power lithium ion battery
  - 132 cells, Saft Li-Ion VL 30 P
  - 11 modules of 12 cells
  - Battery management system
- System capabilities
  - 100 kW / 1 minute
  - 14 kWh
- Can operate as stand-alone UPS system
- Also configured to interact with Capstone 60kW microturbine
- 100 kW SatCon PCS

Southern Company Services

100-kW BESS

Preliminary Test Results



Field Demonstration at A E P

- AEP uses the System as UPS
- The System has been installed and commissioned
- AEP will characterize the battery, and based on the test results, they expect to find a customer site

Saft Observations

- Storage for supporting Distributed Generation (DG) expected to be mainly high power devices
- Lithium ion expected to be a major contender in this area

Saft Research Priorities

- Manufacturing Development / Cost Reduction
- Target Performance Capability for Energy Storage
- Integrated Systems, e.g.,
  - Li-Ion
  - Solar Panel
  - Storage & Power components

Acknowledgements

The continuous support of the U.S. Department of Energy (US DOE) and the US Advanced Battery Consortium (USABC) during the development of the Ni-MH and Li-Ion battery technologies is highly appreciated. Also, Saft is indebted to the US DOE for the sponsorship of the Energy Storage Systems (ESS) Program, as well as Sandia National Laboratories for administering this Program. Saft appreciates the work of Southern Company Services and American Electric Power (AEP) for hosting the two Saft Li-Ion Battery/Sat Con PCS systems for testing and evaluation.

Also, Saft would like to thank DaimlerChrysler for the opportunity to develop the full size HEV Li-Ion battery for the DaimlerChrysler Town & Country Natrium fuel cell concept - hybrid electric vehicle.