Choosing the **right power source** for **smart metering applications**

Utility mangers see long-term value in eliminating manual or drive-by meter reading in favour of more automated processes, which leads to increased productivity, enhanced data capture, and improved customer service through continuous monitoring of customer demand and usage patterns.

According to Glenn Emelko, former executive director of Technology for Aclara, "utility customers demand robust solutions that offer the lowest total cost of ownership. Long life and system reliability are both essential."

Smart decisions for smart meters – a battery technology guidance

Designing a smart meter system to deliver 20+ years of maintenance free performance before replacement is a challenging process. Usually, the manufacturer demand is focused on small and environmentally rugged power sources that provide high voltage per cell, and deliver a good cost/performance ratio. Primary batteries can provide the power required in these applications, particularly for gas meters where safety requirements exclude rechargeable solutions.

Design engineers must determine which of the battery technologies available on the market has the characteristics required by the application. There are a number of technologies to choose including zinc carbon, zinc air, alkaline, and a variety of lithium-based chemistries.

Lithium-based battery technology remains the preferred choice for long-life smart meters due to its distinguished electrochemical properties which exceeds those of all other metals. Lithium is the lightest metal, and offers the highest specific energy and energy density of all available battery chemistries.

When extremely long battery life, extended temperature range and reduced battery size and weight are important considerations, the lithium battery of choice is lithium thionyl chloride, which is available in two styles: bobbin or a spirally wound construction. Both spirally wound and bobbin-type lithium thionyl chloride uses a non-aqueous electrolyte, resulting in relatively high impedance. Spirally wound cells reduce this impedance by increasing the surface area of the anode and the cathode. This reduces overall performance, including lower energy density (due to more inactive material within the cell) and shorter operating life (as extra surface area leads to higher self-discharge rate). Spirally wound cells typically have a maximum service life of about 10 years. By contrast, bobbin-type Li/$SOCl_2$ cells are capable of delivering far higher energy density (1420 Wh/l), higher capacity and are able to withstand extreme temperatures (-55 °C to +130 °C) and offer extremely long service life of up to 20+ years due to low annual self-discharge (< 1% per year).

There are a growing number of applications that require high current pulses, presenting technical challenges to both spirally wound and bobbin-type lithium batteries. Bobbin-type cells have the ideal capacity and energy density, but only allow low current pulses due to their low rate design. To overcome this, the solution most often implemented

Tadiran Batteries has access to decades of real time discharge tests with various cell types, including the XOL type suitable for 25 years of operating life. This data allows for reliable prediction of battery life under real application conditions. In order to allow for accurate predictions, it is also necessary to consider the effect of voltage loss being caused by an increase of internal resistance when substantial current pulses are applied to the battery.

Tadiran's Hybrid Layer Capacitor (HLC) was introduced more than 15 years ago. This technology is based on electrodes comprising lithium intercalation compounds. Major properties of the HLC are especially developed for 25+ years of operation in conjunction with a primary lithium battery, such as:

- improved sealing system (LASER welding, glass-to-metal feed through)
- improved temperature behaviour (–40 °C to +85 °C)
- decreased leakage current (approximately 10 times less than lithium-ion batteries or super caps)

Further the HLC features a low internal resistance throughout the whole battery life which is suitable for reliable life time prediction. All these properties are under continuous evaluation for database maintenance.

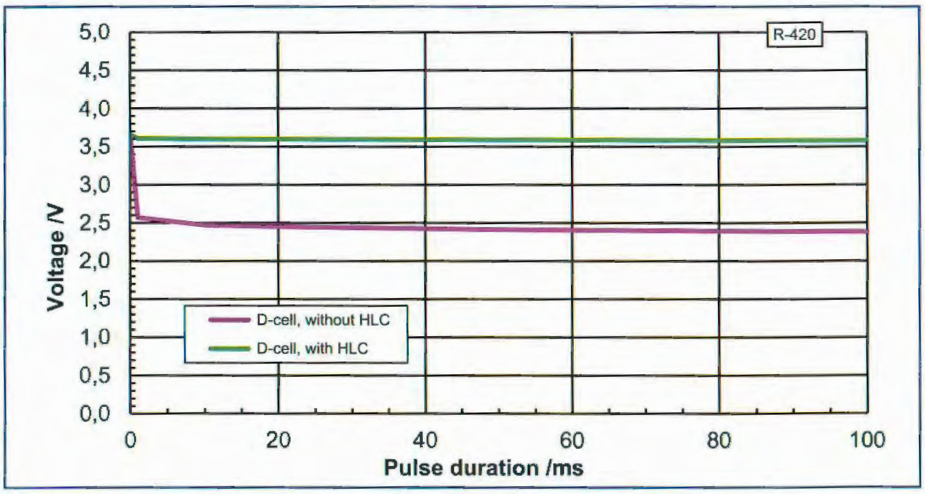

Figure 1: Pulse test, D-cell @ RT under 30 mA pulse load after 15 years on background load. The purple curve represents the cell during the 30 mA pulse, voltage drops below 2.5 volts due to the voltage loss caused by impedance growth. The green curve represents the cell with HLC. The voltage loss is fully compensated by the HLC and operating voltage stays well within expected parameters.