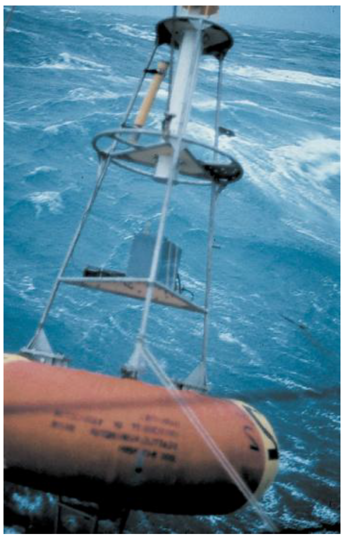
ELECTROCHEM®
AN ULTRALIFE COMPANY

Customized Battery Solutions
in Tsunami Detection Buoys

CASE STUDY



The engineers in California credit the Electrochem team for providing researchers with a power solution that fits all of their needs. With this trusted power source in place, marine engineers can set their concerns aside and concentrate their efforts on advancing the science of early tsunami detection.

Each year, tsunamis come ashore with little warning, taking lives, damaging property and disrupting communities indefinitely. Marine technologists are continually striving for ways to advance the warning systems that protect residents from the dangers of a these tragic waves. With these efforts, it is critical that accurate and real-time assessments of deep ocean wave activity are transmitted to shore. Observation and research of such statistics is currently underway through the use of a buoy and satellite system.

The Application:

This system, actively deployed around the globe, consists of an ocean-floor sensor which communicates pressure measurements and wave heights to a floating surface buoy above. Readings between the two units are transmitted to a positioned satellite which relays the latest data back to shore. In their initial design, marine engineers in Southern California incorporated alkaline battery packs to power the various components in the buoy as well as the ocean floor unit. Located near San Diego, their station serves as one of the main hubs for oceanographic and seismic surveillance research in the world.

Situational Analysis:

At first, alkaline chemistry seemed to be a logical choice; it was relatively inexpensive and easy to both transport and dispose. But, engineers needed more from their power source for this mission-critical application. Although the up-front cost of Alkaline was low compared to other chemistries, there was a significant portion of the research budget spent on the logistics of replacing the alkaline battery pack at the conclusion of its modest life cycle. These growing costs prompted one designer to look at primary lithium as a power source for these critical devices.

Non-rechargeable lithium offers nearly triple the energy density at 900 Wh/L versus alkaline's 320 Wh/L. Electrochem's lithium chemistry can also deliver up to 3.9 V whereas alkaline can only provide 1.5V. Beyond this, lithium can deliver in a temperature range of -55°C to +200°C where alkaline's boundaries are a much more narrow range of -20°C to +54°C (see chemistry comparison chart on page two for more details).

The Electrochem Solution:

Electrochem met with representatives from the Southern California research facility to fully understand the needs of this buoy and how Electrochem's cells and packs could easily increase the duration of a single buoy deployment through the high power density of primary lithium.

Working together, Electrochem and the marine engineers designed a custom pack to fit the tsunami system's specifications. The superior nature of the Electrochem cells allowed the buoy and ocean floor unit to receive the same amount of power from the primary lithium pack at less than half the volume of alkaline.

In addition, it was evident that longer deployment would mean less replacement costs and more continuous data collection. For a D size cell, alkaline will provide approximately 22.5 Watt hours whereas primary lithium will deliver for up to 59 Watt hours; nearly three times longer.

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This custom system allowed the battery to ship in a disconnected state within the glider; once the glider reached its destination, the only step left to take was the activation of the device.

The decision was made to create a custom lithium pack that would deliver more than twice the capacity of alkaline for the same volume that was previously in the device. The resulting lithium pack configurations consist of 16, 20, 24, and 48 cell combinations of DD size cells. These cells leverage Electrochem's spiral wound technology and enhanced bromine chloride chemistry to deliver up to 240 amp hours of power per pack to the system. In addition to performance, the transportation of Electrochem cells is easy. All Electrochem non-rechargeable lithium cells and packs are DOT approved so there is no extra hassle in receiving custom orders in California.

With a vital tsunami detection system such as this, the cost of device failure due to power loss can be as high as death. The engineers in California credit the Electrochem team for providing researchers with a power solution that fits all of their needs. With this trusted power source in place, marine engineers can now set their concerns aside and instead concentrate their efforts on advancing the science of early tsunami detection.

The Facts:

A Comparison of Primary Lithium vs. Alkaline Chemistries

Chemistry Chart:	**Lithium**	**Alkaline**
Operating Temperature Range	-55° C to +200° C	-20° C to +54° C
Energy Density	14.7 Wh/in^3 / 900 Wh/L	5.2 Wh/in^3 / 320 Wh/L
Nominal Voltage	3.9 V / 3.6 V	1.5 V
Watt Hours (for D size cell)	59.0	22.5
Advantages	- Ideal in high shock and vibration environments - Very high open circuit & nominal load voltages - Lighter weight than Alkaline (lower pack weight, easier field service, easier handling) - Internally fused - Hermetically sealed – no risk of hydrogen generation or outgassing - Possible lower "total" cost	- Easier to transport - Easier to dispose - Lower unit cost
Disadvantages	- Requires knowledge of appropriate safety and handling	- Limited temperature range - Short life cycle - Low power density per cell - Not hermetically sealed - No internal safety fuse - Possible hydrogen outgassing

Source: Linden, D.; Reddy, T.B. (2002). Handbook of Batteries (3rd Edition). McGraw-Hill.