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TECHNICAL GUIDE

LiFe² for Industry

Moving Remote Sites from Lead-Acid to Lithium



Cathodic Protection · Remote DC Sites

Technical Guide

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Document

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Asset owners, engineers and site designers

Applications
Cathodic protection skids · SCADA · telemetry · remote DC sites

Battery
LiFe² 5120S, 5.12 kWh LFP, 51.2 V DC

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A4 · 16 pages

Foreword

Many cathodic protection (CP) skids, SCADA huts and telemetry sites still run on lead-acid batteries. They work, but they wear out fast in the heat, they don't like sitting part-charged through winter, and they give little warning before they fail.

This guide is for the people who own and design those sites. It answers the questions we hear most often about moving to lithium: is it safe, will it cope with the heat, what happens when something fails, and what changes on the skid. Every figure comes from the LiFe² 5120S datasheet and manuals unless it says otherwise.

For installation, wiring and settings, use the LiFe² 5120S Installation and Operation Manual, the PCE Integration Guide and the System Sizing Guide, at aerl.com.au.

The Short Answers

Concern	Short answer
Is lithium safe?	The LiFe² uses lithium iron phosphate (LFP), one of the most heat-stable lithium chemistries. Every module has its own battery management system (BMS) and its own 125 A breaker. The cells are tested to UL 9540A and IEC 62619.
Will it cope with the heat?	It has no fans to fail. It keeps its full rates to a battery temperature of 45 °C and keeps working, at lower rates, to 55 °C. Its cycle-life data at 45 °C shows about 4500 cycles to 70% capacity. A cool enclosure still gives the longest life.
What if a module fails?	The modules are in parallel, not in series. A faulty module disconnects itself and the rest keep supplying the site. Fit one or two more modules than you need and you have N + 1 or N + 2.
What if the comms fail?	Run the battery Managed, talking to the chargers over CAN bus. With CoolMax SRX chargers and supported inverters, if the link is lost it falls back to Self-Managed operation automatically and keeps supplying the site.
Can it replace our lead-acid?	Yes. It is a 48 V-class battery (51.2 V nominal) and works with CoolMax SRX charge controllers.
Can our SCADA see it?	Yes. A Nexus Gateway collects the battery and SRX data on site and serves it over Modbus TCP, with no internet connection needed.
What maintenance does it need?	No watering, no equalising, no fans or filters. Check the site, the connections and the breakers on your normal visits.

Why Move from Lead-Acid

What changes, why it matters on a CP skid

01

1.1 What Changes

	Lead-acid (typical)	LiFe² 5120S
Usable energy	About 50% of nameplate, for a long life	80% of nameplate by default (up to 100% allowed)
Life in the heat	Rated at 20–25 °C. Roughly halves for every 8–10 °C hotter	About 4500 cycles to 70% at 45 °C
Left part-charged	Sulphates and loses capacity	No harm. Needs a regular full charge (every 14–30 days) to keep its state of charge (SOC) reading accurate
Weight per usable kWh	About 50–60 kg	About 11 kg (44 kg per module, at 80% depth of discharge)
How it's built	One series string of 2 V cells	Parallel modules, each with its own BMS and breaker
One bad cell	Can take the whole string down	Takes one module out. The rest keep running
Gassing	Vents hydrogen when overcharged	Sealed. No gassing in normal use
What you can see	Bank voltage	State of charge, health, cell voltages and temperatures, and alarms, on your SCADA
Maintenance	Watering (flooded), equalising, cell checks	None on the battery itself

Lead-acid figures are typical values for stationary lead-acid batteries, not a specific product. Check your own battery's datasheet.

1.2 Why It Matters on a CP Skid

A CP skid runs a small, steady load around the clock. The battery charges by day and supplies the site by night, every day, often in a hot steel enclosure far from anyone who can check it. That is hard on lead-acid: heat shortens its life, and a run of cloudy winter days leaves it part-charged, which sulphates the plates. The bank fades quietly until the CP output drops out.

Heat costs the LiFe² far less life, sitting part-charged doesn't harm it, and it reports its state, so you can see a problem before the CP output drops.

Safety

Why LFP, tested and certified, layers of protection

02

2.1 Why LFP

There are several lithium chemistries. The LiFe² uses lithium iron phosphate (LFP, LiFePO4). LFP cells are much harder to drive into thermal runaway than the nickel-based cells (NMC) used in many cars and home batteries, because their cathode does not release oxygen the same way when overheated. LFP contains no cobalt.

2.2 Tested and Certified

Level	Standards
Cell	UL 1973, UL 9540A, IEC 62619:2022, UN 38.3
Battery module	IEC 62619:2022, IEC 62040-1, UN 38.3, CE

UL 9540A is the test method for thermal runaway fire propagation; the LiFe² cells are tested at cell level. IEC 62619 sets the safety requirements for industrial lithium batteries. UN 38.3 covers transport.

2.3 Layers of Protection

Each LiFe² module protects itself. Its Battery Management System (BMS) watches every cell and acts on:

- **Cell over-voltage:** disconnects at 3.65 V per cell.
- **Cell under-voltage:** disconnects at 2.55 V per cell.
- **Over-temperature:** cuts off at 56 °C.
- **Low temperature:** stops charging (and, colder still, discharging) below its limits.
- **Overcurrent and short circuit:** the module's own 2-pole 125 A breaker trips.
- **Internal fault:** the BMS trips the breaker electronically.

The BMS also balances the cells actively, so no cell drifts high or low over the years.

2.4 For Your Safety Case

Item	Value per module
Short-circuit current	2000 A
Arc flash incident energy (at 45 cm)	0.341 cal/cm²
Arc flash boundary	About 24 cm

Item	Value per module
Integrated breaker	2-pole, 125 A, 80 V DC
Weight	44 kg

These values are for one module. In a bank, the fault current adds up: 2000 A for each module in parallel. Rate the DC isolation for the whole bank, and assess the arc-flash hazard at the bank busbar and DC isolator, not at one module.

Installation standards

Install to AS/NZS 5139 and AS/NZS 3000. AS/NZS 5139 needs 2-pole DC isolation (MCCBs) between the battery and the charger or DC bus. The LiFe² cabinets have no DC breaker of their own, so fit it outside the cabinet.

Fire

A failing LFP battery can still release smoke and flammable gases. If a battery enclosure is smoking or venting, keep clear and call 000. Fight a battery fire only with a full-face breathing apparatus (SCBA) and full protective gear, using a dry chemical extinguisher. See the LiFe² 5120S Safety Data Sheet.

Hazardous areas

The LiFe² has no hazardous-area (Ex) certification. Install it outside any classified zone, as you would other non-Ex electrical equipment on the skid.

Redundancy: Every Module Stands Alone

03

Parallel, Not Series, build in N + X

3.1 Parallel, Not Series

A 48 V lead-acid bank is 24 cells in series. Every cell carries the full current, and one weak or open cell can take the whole bank down.

A LiFe² bank is built the other way. Each module is a complete 48 V-class battery, with its own cells, BMS and breaker. The modules are connected in parallel (series connection is not permitted), up to 64 of them. If one module trips or fails, the others keep supplying the site at the same voltage. You lose that module's share of the capacity, not the site.

3.2 Build in N + X

Because each module stands alone, redundancy is just a matter of fitting more modules than the site needs:

1. Size the bank for the load and the days of autonomy you need. That is **N** modules.
2. Add one or two more. That is **N + 1** or **N + 2**.
3. Choose a cabinet with room for them. The outdoor cabinets take 4, 6 or 10 modules.

On a normal day the spare modules share the load, so every module works a little less hard. On a bad day the site keeps its full autonomy with a module out.

N + X covers a fault in one module. It doesn't cover a problem that hits every module at once, such as an overheated enclosure or a bank run flat. Design the enclosure and the charging for those (chapters 04 and 05).

3.3 Worked Example: N + 2 on a CP Skid

Step	Working
Load	A CP unit drawing 8 A at 51.2 V: 410 W, or 9.8 kWh a day
Autonomy	3 days without sun: 29.5 kWh
Usable energy per module	4.096 kWh (Managed, 80% depth of discharge)
N	29.5 ÷ 4.096 = 7.2, rounded up to 8 modules
Installed	10 modules in a LiFe²-CAB10-OUTD (51.2 kWh, IP55)
Result	N + 2. With two modules out, a new bank still has its full 3 days

Capacity fades with age, to 70% at end of life. To keep the full margin for the life of the bank, size N on 70% of the usable energy. Your own numbers will differ. The LiFe² 5120S System Sizing Guide sets out the full method, including charge current and cabinet limits.

3.4 Swapping and Adding Modules

- **Swapping:** a module can be swapped while the rest of the bank keeps supplying the site. Switch the module off with its **ON/OFF** button and open its breaker before you unplug it. Reconnect the comms chain past the removed module, so the modules after it stay on the chain.
- **The master module:** swapping the master module (the one wired to the chargers) needs a brief interruption.
- **Adding:** new modules can be added at any state of charge during the warranty period. The bank balances itself, bringing the new module to the voltage and SOC of the others. All modules must be the same part number.
- **Spares:** a spare module can be fitted by a qualified technician on the next site visit, with no matching or conditioning. In storage, check its voltage every 3 months and charge it if it is below 51.6 V (AERL Battery Handling Guide).

3.5 Managed, with Automatic Fallback

Run the LiFe² in **Managed** mode. The master battery talks to the chargers over CAN bus: it sends its state of charge, its charge and discharge limits as the temperature changes, and its alarms. The chargers work within those limits.

> **Automatic fallback to Self-Managed**
>
> If the comms link is lost (a damaged cable, a failed connector, a charger swapped out), the LiFe² falls back to **Self-Managed** operation by itself. Each module's BMS keeps protecting its own cells, the chargers carry on with the LiFe² settings programmed into them, and the site keeps running. When the link is restored, the battery returns to Managed mode automatically. No one has to visit site to reset it.

That gives two independent layers: the chargers follow the battery's limits while the link is up, and each module protects itself whether the link is up or not.

At commissioning, program every charger with the LiFe² Self-Managed settings (no more than 56 V, no more than 70 A per module across all chargers, and no more than the cabinet's busbar rating) as its fallback. Fallback applies with supported chargers and inverters. Some inverters stop, or can be set to stop, when they lose the battery's data (a Victron system, for example): check this at commissioning.

If the master module itself fails or is removed, the other modules switch to Self-Managed and run independently, without interrupting supply. Bank data stops reaching the chargers and the Nexus Gateway until the master is replaced.

High Temperatures and Passive Cooling

04

How hot it can run, why the heat limits Rarely Bite on a CP skid

4.1 How Hot It Can Run

Battery temperature	Charge	Discharge
20–45 °C	Up to 1C (100 A per module)	Up to 1C (100 A per module)
45–50 °C	Up to 0.5C (50 A per module)	Up to 0.8C (80 A per module)
50–55 °C	Up to 0.2C (20 A per module)	Up to 0.6C (60 A per module)
56 °C	BMS cuts off	BMS cuts off

These are battery (cell) temperatures, not air temperatures, from the LiFe² Installation and Operation Manual, chapter 12. Below 20 °C the rates also fall (Cold Sites, below).

In Managed mode the battery sends these limits to the chargers as its temperature changes. In Self-Managed operation the chargers don't know them, and the BMS can only disconnect a module that goes past them. So set the fallback charge current for the hottest battery temperature you expect: no more than 20 A per module if the battery can reach 50 °C.

4.2 Why the Heat Limits Rarely Bite on a CP Skid

A CP load is small. In the worked example (chapter 03), the CP unit draws 8 A from a ten-module bank: under 1 A per module, or less than 0.01C. Even at 50–55 °C each module may discharge at 60 A. On the charge side, ten modules accept 200 A at 0.2C. For comparison, one CoolMax SRX 600/70-48 delivers up to 70 A.

4.3 Life in the Heat

Battery temperature	Cycles to 70% capacity (80% depth of discharge)	Years at one cycle a day
25 °C	About 7000	About 19
35 °C	About 5500	About 15
45 °C	About 4500	About 12

These are laboratory cycle-life figures, from the LiFe² Installation and Operation Manual, chapter 11. A shallower daily cycle gives more cycles. Batteries also age with time, faster when hot, so a cool, shaded enclosure still adds life. The warranty is up to 10 years (chapter 07). Lead-acid in the same 45 °C enclosure would typically last a small fraction of its rated life.

4.4 No Fans, Nothing to Fail

The LiFe² is cooled by natural convection. There are no fans, filters or air-conditioners to fail, block with dust or service. On a remote skid that matters: a failed fan on an actively cooled battery is a site visit.

4.5 Keeping the Enclosure Cool

Passive cooling works when the enclosure lets the heat out. In the field that means:

- **Keep the sun off it.** Shade the battery enclosure, or fit a sun shield with an air gap. Never install in direct sun.
- **Let air move.** Keep vents clear. In a custom enclosure, leave at least 30 mm around each module.
- **Keep it away from heat.** The manual asks for at least 5 m from any heat source. Don't share a sealed compartment with a transformer-rectifier. Where a skid can't, have AERL review the layout.
- **Mount it low and on the shaded side** of the skid where you have the choice.
- **Measure it.** The battery reports its cell temperatures, so you can see how hot it really gets through summer (chapter 06).
- **Check the other equipment too.** The CoolPro CP30 on a 36 V or 48 V input is rated to 50 °C ambient. On a hot skid, it may be the limit before the battery is.

> **Ratings and warranty**
> The LiFe² is suited to hot sites as long as it stays within its ratings: the battery temperature limits above, and no sustained ambient temperature above 55 °C or below −20 °C (the warranty limits). The cooler it runs, the longer it lasts.

4.6 Cold Sites

Mode	Charge	Discharge
Managed	−10 to 55 °C	−20 to 55 °C
Self-Managed	0 to 55 °C	−5 to 55 °C

Managed operation gives the widest range: the battery charges down to −10 °C (at no more than 0.1C below 0 °C). Self-Managed operation stops charging at 0 °C. On a frosty site, also fit an AERL Battery Sense and turn on the SRX's low-temperature charge cutoff (off by default), so the battery is still protected if it falls back to Self-Managed. Fitting a Battery Sense also turns on the SRX's temperature compensation (50 mV/°C by default): set it to 0 mV/°C for the LiFe².

Replacing Lead-Acid on a CP Skid

05

What stays the same, what changes, deep discharge

5.1 What Stays the Same

- **Voltage:** the LiFe² is a 48 V-class battery: 51.2 V nominal, 40.8–58.4 V operating. Check that the CP unit and other loads accept that range. The CoolPro CP30 accepts up to 60 V.
- **Chargers:** CoolMax SRX and SRX-R 48 V charge controllers charge the LiFe² directly. One module is the minimum for either.
- **Layout:** each module is a 19-inch, 3U rack unit (440 × 134 × 480 mm). It fits a 600 mm deep 19-inch rack, or one of AERL's pre-wired cabinets.

5.2 What Changes

Item	What to do
Comms	Connect the master battery's COMM port to the chargers' CAN bus (shielded Cat 5, no longer than 5 m), with the Nexus Gateway on the same bus. Check with AERL that the chargers' firmware is current.
Charge settings	Program every charger with the LiFe² fallback settings: no more than 56 V, and no more than 70 A per module across all chargers, and no more than the cabinet's busbar rating. On a hot site, less (chapter 04). Set the SRX charge profile in AERL Link.
Equalisation	Turn it off. Equalisation is for flooded lead-acid only and damages lithium.
Temperature compensation	Not needed for the LiFe². Set it to 0 mV/°C.
Depth of discharge	Design for 80% (down to 20% SOC). On a DC-only skid, nothing stops the load at 20% SOC unless the load has its own low-voltage disconnect: otherwise the bank runs down to the BMS cut-off. Size the autonomy so it doesn't get there.
Full charge	Make sure the battery reaches 100% at least every 30 days (every 14 days if it is running Self-Managed), so its SOC reading stays accurate. Size the solar array for the winter solstice.
DC isolation	Fit 2-pole DC breakers (MCCBs) between the battery and the DC bus, rated for 2000 A short-circuit current per module.
Earthing	Earth each module, and the cabinet with a PE cable of at least 25 mm².
Enclosure	Use an AERL outdoor cabinet (IP55) or an existing enclosure with the clearances and ventilation in chapter 04.

5.3 Deep Discharge

A lead-acid bank run flat is usually ruined. A LiFe² module protects itself: its BMS shuts it down before the cells are damaged.

Recovery is automatic: when the solar returns, the bank powers up and starts charging again, with no site visit. Only an extreme discharge trips a module breaker, which then needs resetting on site.

Two things to plan for:

- **Recharge within 10 days** of an automatic shutdown, to restore a healthy state of charge.
- **Don't leave it flat.** A battery left at 5% SOC or less for more than 30 days is not covered by the warranty. Size the autonomy and the solar array so this can't happen, and use remote monitoring to catch it.

5.4 Getting the Batteries to Site

- Each module weighs 44 kg: lift it with at least two people, using lifting aids if needed. The outdoor cabinets weigh 52–142 kg empty and have lift points.
- Lithium batteries ship as Class 9 dangerous goods (UN3480). They leave AERL at a low state of charge, as transport rules require. Give them their first full charge on commissioning.
- See the AERL Battery Handling Guide for storage and transport.

Seeing Inside the Battery

What the battery reports, into your SCADA, locally

06

With lead-acid, you find out a bank has failed when the CP output drops. A LiFe² bank tells you how it is doing, down to the cell.

6.1 What the Battery Reports

Over its CAN comms, the LiFe² reports:

- **Bank:** state of charge, state of health, voltage, current and temperature.
- **Cells:** the highest and lowest cell voltages and cell temperatures, and which module and cell they are in.
- **Balancing:** cell imbalance warnings and alarms.
- **Cycles and life:** cycle count and state of health, for planning replacement on condition instead of by the calendar.
- **Modules:** each module's operating state, and how many modules are offline.
- **Alarms and warnings:** high and low cell voltage, high and low temperature, overcurrent and the rest, as they happen.

6.2 Into Your SCADA, Locally

An AERL Nexus Gateway sits on the skid's CAN bus and collects the data from the LiFe² bank and the CoolMax SRX charge controllers together. It serves the data on the site network over **Modbus TCP** (port 502), so your SCADA or RTU polls one device for the battery and the chargers.

The Nexus runs entirely locally. It needs no internet connection, no cloud account and no outbound traffic, which suits sites on a closed operational network. The Modbus TCP interface is read-only: it can't change a setting on the battery or the chargers. A Nexus that never connects to AERL Cloud doesn't update itself: ask AERL how to keep its firmware current.

If you also want AERL Cloud dashboards and alerts, the same Nexus can send data to AERL Cloud over Ethernet, Wi-Fi or 4G (Nexus 4G). That's optional: the Modbus TCP interface works the same either way.

The register map is in the Nexus Modbus TCP Protocol, at aerl.com.au.

Life, Warranty and End of Life

Warranty, end of life

07

7.1 Warranty

Product	Warranty
LiFe² 5120S module	5 years, or 10 years if registered within 60 days of installation. Warranted to keep 70% state of health, up to 15.36 MWh energy throughput, on a once-daily cycle
LiFe² cabinets	2 years

Register at aerl.com.au/warranty-registration. A module connected to AERL Cloud within 60 days is registered automatically; a site that runs offline must be registered by hand. Full terms are in the LiFe² Warranty Statement, at aerl.com.au.

7.2 End of Life

Return LiFe² modules to AERL at the end of their life. Modules that can be refurbished are tested and passed on for charitable, community or educational use. The rest are recycled.

Questions for Your Site

08

Bring these to AERL and we can size the bank and the enclosure with you:

1. What does the site draw, in amps at 48 V, and does it vary through the day?
2. How many days of autonomy do you need without sun?
3. What are the charge sources: solar through SRX controllers, a generator, a mains charger?
4. How hot does the current battery enclosure get in summer, and is it in the sun?
5. How much redundancy do you want: N + 1 or N + 2?
6. Is the skid inside a hazardous-area zone?
7. Does your SCADA or RTU poll Modbus TCP, and is the site network closed to the internet?

Talk to AERL

AERL designs, supplies and supports power conversion, lithium storage, monitoring and cathodic protection equipment for oil and gas, mining and telecommunications sites across Australia.

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