



NATIONAL POWER
CONTRACTORS (PTY) LTD

Critical Power Continuity System for Underground Instrumentation

Solid-State Graphene Supercapacitor Battery • Safe • Intelligent • Redundant • Plug-and-Play

Exclusive Distributor — Southern Africa
Graphene Supercapacitor Battery Systems



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Made in South Africa



20,000+

Charge Cycles



20+ Years

Design Life



12.5 kWh

Energy Capacity



50% Lower

Lifecycle Cost vs Lithium



10-Layer

Protection System



-10 to +40°C

Operating Range



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National Power's underground instrumentation backup system is a fully integrated, intelligent and redundant power-continuity solution built around a UL 8250-certified solid-state graphene supercapacitor battery — engineered for the harsh realities of underground mining, where conventional lithium-ion UPS systems simply are not safe enough:

- 1** | Inherently safe — solid-state, non-flammable chemistry with zero thermal runaway.
- 2** | Dramatically longer-lasting — 20,000+ cycles and a 20+ year design life.
- 3** | Half the lifecycle cost of lithium-ion — no mid-life replacements.
- 4** | Built for the environment — 100% recyclable and non-toxic.
- 5** | Proudly designed and assembled in South Africa.

The System — Built for Underground

One integrated, plug-and-play enclosure

Everything needed for safe, continuous underground backup power is built into a single ruggedised IP66 cabinet — ready to wheel in and connect:

- Victron MultiPlus-II 5 kVA inverter — continuous AC power
- Solid-state graphene supercapacitor battery — 12.5 kWh, UL 8250 certified
- Siemens S7-1200 PLC supervisory control with SCADA
- Multi-layer AC/DC protection, ultrafast fuses & FirePro® suppression
- Guaranteed 20,000 cycles
- 100% DOD — ½ the cost per cycle of lithium-ion

What Is Graphene? — In Brief

Graphene is a single layer of carbon atoms arranged in a hexagonal lattice — just one atom thick, yet the strongest material ever measured and one of the finest known conductors of electricity and heat. That same honeycomb structure, shown faintly across these pages, is what gives the technology its remarkable properties.



A different way to store energy — the graphene supercapacitor stores charge physically in an electric field, instead of relying on the slow chemical reactions used by lithium-ion batteries.



Inherently safe — solid-state with no liquid electrolyte; the chemistry is non-flammable and cannot enter thermal runaway.



Extraordinary lifespan — hundreds of thousands of charge/discharge cycles with negligible degradation (20,000+ guaranteed, up to 43,000).



Fast and efficient — near-instant charge and discharge, 95% round-trip efficiency and 100% depth of discharge.



Stable across temperature — performs from -10°C to +40°C with no derating.

Optional enclosure air-conditioning is available if required.



Clean and green — 100% recyclable, non-toxic materials with zero hazardous waste.



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The Graphene Supercapacitor Cell

98 Wh · 4.2 V — the core building block of every system



**Graphene Supercapacitor Cell — 98 Wh ·
4.2 V**

Each individual graphene supercapacitor cell delivers **98 Wh at 4.2 V** in a lightweight, solid-state pouch format. There is **no liquid electrolyte**, making the cell inherently safe, non-flammable and incapable of thermal runaway.

Cells are assembled and configured in series/parallel to build the **12.5 kWh** system battery, managed cell-by-cell by the BMS for balancing, monitoring and protection.



98 Wh · 4.2 V



Solid-state pouch



No liquid electrolyte



Per-cell BMS



Incapable of thermal runaway

About National Power Contractors

A registered Energy Services Company with over **25 years** of project development experience and a verified track record of **2,832 GWh** of metered and verified energy-efficiency projects. As the **Exclusive Distributor for Southern Africa** of Graphene Supercapacitor Battery Systems, National Power brings cutting-edge, locally supported technology to the mining and commercial sectors — engineered, assembled and supported in South Africa.

25+

Years of experience

2,832 GWh

Metered & verified projects

Exclusive

Distributor — Southern Africa



Engineered & assembled in SA

Fire Hazard Mitigation — The Critical Differentiator

Zero Thermal Runaway. Inherently Safe Chemistry.



Why the chemistry is safe

- ✓ Solid-state construction — no liquid electrolyte
- ✓ Non-flammable, inert chemistry by design
- ✓ Cannot undergo thermal runaway under any load
- ✓ Oxygen-reduction suppression — starves any combustion
- ✓ FirePro® capsule activates automatically at 300°C
- ✓ Shunt trip isolates battery & inverter instantly



Active protection layers

- ✓ Heat detection: FirePro® triggers at >300°C
- ✓ Shunt trip: PLC disconnects all breakers instantly
- ✓ System isolation: inverter & battery safely disconnected
- ✓ SCADA monitoring: real-time alarms, remote visibility
- ✓ Accelerometers: shock & movement detection
- ✓ Voltage transient suppression on all outputs

Fire Mitigation Strategy — Automated Response Sequence

1



Heat Detection —
FirePro® tablet detects
temperature above 300°C

2



Automatic Activation —
FirePro® releases clean
agent to suppress the fire

3



Shunt Trip Activated —
PLC commands all
breakers open & disconnects

4



System Isolated —
Battery, inverter & all loads
safely disconnected

5



Fire Suppressed —
Oxygen-reduction stops
the combustion process



20,000+
Charge Cycles



20+ Years
Design Life



12.5 kWh
Energy Capacity



50% Lower
Lifecycle Cost vs Lithium



10-Layer
Protection System



-10 to +40°C
Operating Range



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Key Benefits at a Glance

1



Instant Peak Response

Handles transient and peak loads instantly — no spin-up delay.

Critical for underground emergency and safety systems.

2



No Single Point of Failure

Multi-layer redundancy across hardware, firmware, and communications.

Every protection function has a backup path.

3



Full SCADA Integration

Modbus / Profibus / Ethernet.

Real-time alarms and remote diagnostics from the surface control room.

4



100% Recyclable • Green

No toxic electrolyte. Fully recyclable at end of life. Zero hazardous waste.

Certified IEC, CE, RoHS, UL 8250.

5



Plug-and-Play Deployment

IP66 cabinet — compact, mobile, ruggedized for rapid underground connection.

Minimal installation time.

6



Half the Cost of Lithium

20,000+ cycles and 20+ year design life — dramatically lower total cost of ownership, no mid-life replacements.

7



Quick Charge & Discharge

Charge at ¼C and discharge at ½C, with 95% round-trip efficiency and 100% depth of discharge — built for rapid cycling.

8



Per-Cell BMS

Every cell carries an embedded Battery Management System with a direct-contact temperature sensor, continuously monitored. Each cell's voltage and temperature are managed, with feedback sent to the control loop to isolate the cell array if required.



Graphene Supercapacitor vs Conventional Lithium-Ion

Conventional Lithium-Ion UPS	National Power Graphene Supercapacitor
 Thermal runaway risk — can ignite or explode underground	 Zero thermal runaway — inherently safe solid-state design
 Liquid electrolyte — flammable and toxic	 No liquid electrolyte — non-flammable, inert
 3,000–5,000 cycle life at best	 20,000+ cycle life — outlasts 4–6 lithium replacements
 Degrades rapidly above 40°C	 Operates from -10°C to +40°C with no derating
 High replacement cost every 5–7 years	 50% lower lifecycle cost — no mid-life replacements
 Toxic waste disposal required at end of life	 100% recyclable — clean and non-toxic
 Slow recharge; cannot handle rapid cycling	 Near-instant recharge; built for rapid cycling & high power



10-Layer Protection Architecture

1		Cell-Level Protection — Per-cell BMS with temperature monitoring and balancing
2		Electrical Protection — Over/under voltage, overcurrent, short circuit protection
3		Thermal Protection — Multi-point temperature sensing and active monitoring
4		Mechanical Protection — Rugged IP66 enclosure, shock and vibration resistant
5		Fire Protection — FirePro® automatic suppression at >300°C
6		System Protection — Smart trip isolation and breaker coordination
7		Communication Protection — SCADA watchdogs and communication fail-safes
8		Environmental Protection — Operates from -10°C to +40°C in harsh underground conditions; optional enclosure air-conditioning
9		Data Protection — Event logging, alarms, and remote diagnostics
10		Abuse Protection — Bullet, nail, crush and penetration resistant cells

Control Philosophy

The system is designed with a defense-in-depth philosophy. Multiple independent layers ensure that if one protection layer is compromised, others remain active to protect the system, personnel and asset.



Sense — Continuously monitor all critical parameters



Analyze — PLC logic validates and cross-checks data



Decide — Intelligent decision-making with fail-safes



Act — Automated response and system isolation



Report — Real-time alarms and remote visibility

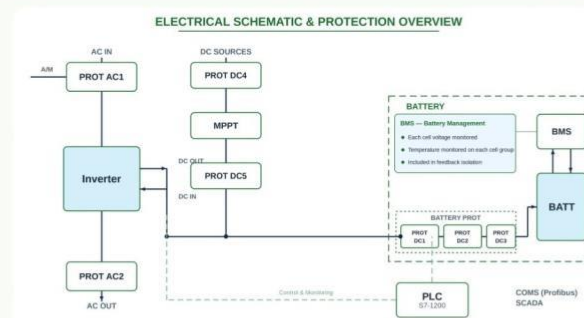


Control Philosophy & Electrical Architecture

Every interface guarded by a dedicated protector block — no single point of failure

The system is governed by a **Siemens S7-1200 PLC** providing supervisory control and interlocking, with **Profibus** communications to **SCADA** for real-time monitoring and remote diagnostics.

Power flows along two protected paths — AC mains via **PROT AC1** → inverter → **PROT AC2** to the load; DC sources via **PROT DC4**, the MPPT and **PROT DC5** onto a shared DC bus. The battery is guarded by **PROT DC1–DC3**, with the **BMS** providing continuous monitoring and feedback. No single point of failure.



Protector Block Matrix

Protector	Isolation (Man / Auto)	Short-Circuit & Overcurrent	Thermal Overload	Electronic	Overvoltage / Surge
AC1	A	Double-Pole CB	CB	FB	Y
AC2	A	Double-Pole CB	CB	FB	Y
DC1	M	Double-Pole CB	CB	FB	—
DC2	A & M (cont.)	BMS	BMS	BMS	BMS
DC3	M (fuse)	Ultrafast Fuse	Fuse	MPPT	—
DC4	M	Fuse Switch	Fuse	—	—
DC5	via DC1/2/3	via DC1/2/3	DC1/2/3	DC1/2/3	DC1/2/3
INV	A	Y SWT/DN	Y S/P	Y	Y S/D
MPPT	A	Y SWT/DN	Y S/P	Y	Y S/D
BMS	Feedback	Feedback	Feedback	Feedback	Feedback

Key: A = Auto · M = Manual · CB = Circuit Breaker · FB = Feedback · S/P = Self-Protect · SWT/DN = Switch-Down · S/D = Shutdown · BMS = Battery Management System · — = not applicable



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Abuse-Test Safety Evidence – Bullet & Penetration Resistant

National Power graphene supercapacitor cells have been subjected to extreme abuse tests. They remain stable, non-flammable, and show zero signs of thermal runaway.



Bullet Penetration



Multiple bullets fired.
No fire. No explosion.



Short Circuit



Dead short — 4,000 A for 1 second.
No fire. No explosion.



Crush Test



Extreme mechanical crush applied.
No fire. No explosion.



Extreme Heat



Exposed to direct flame.
No fire propagation.
Self-extinguishing.



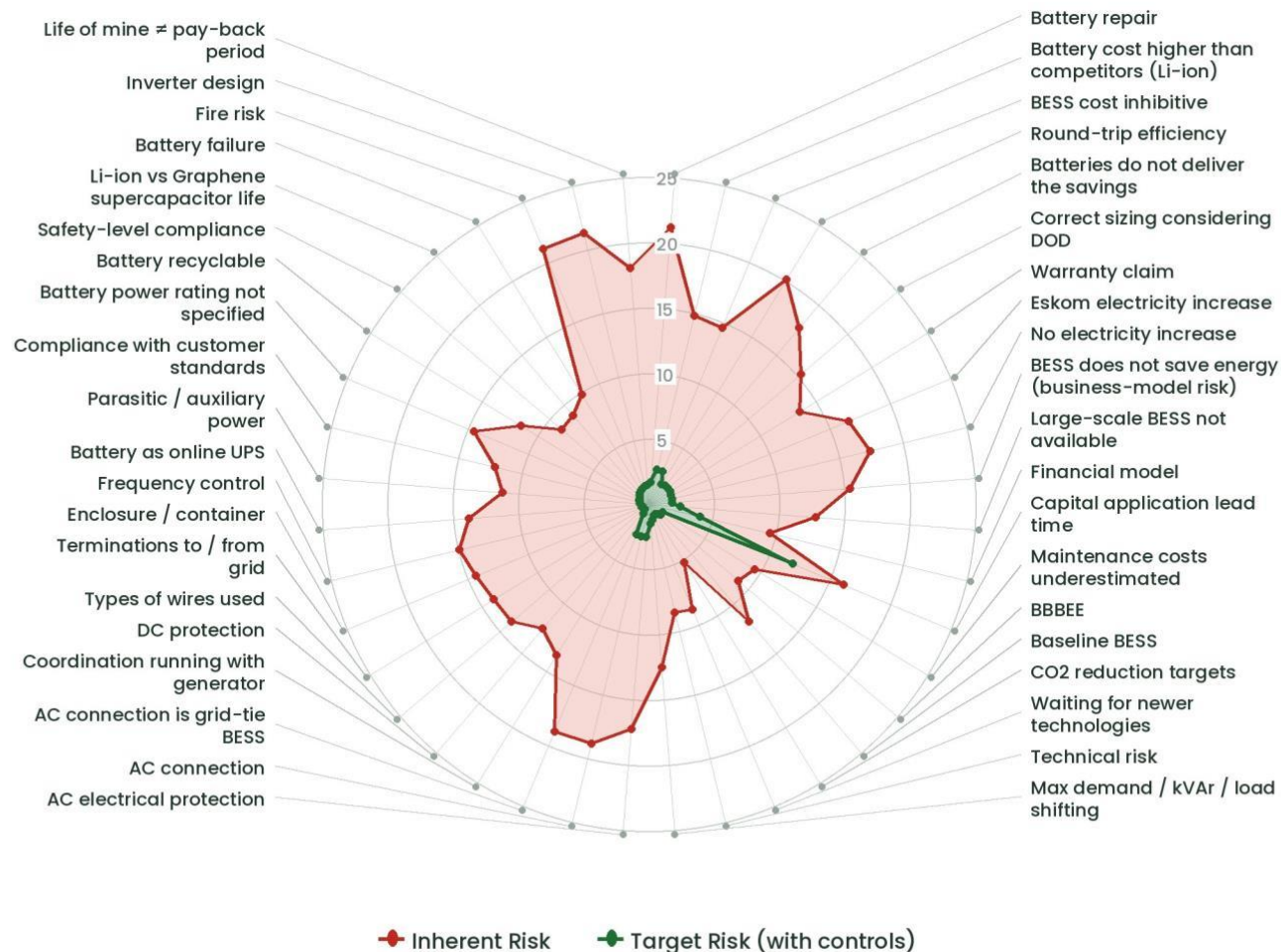
These tests demonstrate the inherent safety and robustness of solid-state graphene supercapacitor technology.



Risk Profile — Inherent vs Target

Residual risk collapses toward the centre once inherent-safety design, redundancy and controls are applied

All identified risks have been mitigated





Risk Profile



Fire Risk — Extremely Low



Explosion Risk — None



Toxicity Risk — None



**Environmental Impact —
Minimal • 100% Recyclable**



Operational Risk — Extremely Low



Lifecycle Risk — Extremely Low

Summary

The National Power Graphene Supercapacitor Backup System delivers unmatched safety, longevity and performance, with a lower total cost of ownership for underground mining applications. It is the safest, longest-lasting and most economical energy storage solution available.

Inside the Enclosure



IP66 Enclosure

Corrosion-resistant, marine grade

DC Distribution & Protection

Circuit breakers & ultrafast fuses

Victron MultiPlus-II 5 kVA

Continuous AC power

Siemens S7-1200 PLC

Supervisory control & SCADA

FirePro® Suppression

Activates automatically at 300°C

Graphene Supercapacitor Battery

12.5 kWh • 20,000+ cycles • 100% DOD

**SAFE. INTELLIGENT. REDUNDANT.
BUILT FOR UNDERGROUND. BUILT TO LAST.**



Proudly designed and assembled in South Africa.



G3SC Demo Unit — Tested for 1 Year Without Failure

Inside the enclosure: power conversion, control, protection and energy storage



Component	Function
Victron MultiPlus-II 48 5000 70	5 kVA inverter / charger – continuous AC power
AC distribution & protection	Circuit breakers, earth-leakage and contactor
Siemens S7-1200 PLC	Supervisory control & SCADA
Siemens SITOP power supply	Regulated DC supply for control circuits
Victron Cerbo GX	System monitoring and communications
DC protection	Ultrafast DC fuses
FirePro® suppression	Activates automatically at 300°C
Graphene supercapacitor battery	20,000+ cycles • 100% DOD
IP66 enclosure	Corrosion-resistant, marine grade

Photograph of the assembled demo unit. Configuration may vary by application.



G3SC Battery Technical Specifications

Product configurations and physical characteristics

Specification	4.2 kWh G3SC	12.6 kWh G3SC
Voltage class	48 V	48 V
Nominal energy	4.2 kWh	12.6 kWh
Nominal capacity	80 Ah	240 Ah
Cell configuration	4 cells in parallel 14 packs in series	12 cells in parallel 14 packs in series
Total capacitors	56	168
Specific energy density	214 Wh/kg	214 Wh/kg
Volumetric energy density	294 Wh/L	294 Wh/L
Module mass	23 kg	85 kg
Module dimensions (W x H x D)	433 x 175 x 384 mm	433 x 175 x 821 mm
Rack format	19-inch, 4 RU	19-inch, 4 RU
Cell-pack resistance (charged / drained)	1.4 / 2.6 milliohm	0.46 / 0.86 milliohm

Specifications are subject to final configuration and the approved manufacturer datasheet.



G3SC Electrical and Operating Specifications

Performance, protection and communications

Specification	4.2 kWh G3SC	12.6 kWh G3SC
Maximum continuous voltage	58.8 V	58.8 V
Maximum surge voltage	59.5 V	59.5 V
Minimum voltage	42 V	42 V
Nominal current at 0.5C	40 A	120 A
Peak current for 5 seconds	120 A	240 A
Maximum charging current	40 A at 0.5C	120 A at 0.5C
Derived capacitance	6,472 F	19,416 F
Peak efficiency	94% at 0.5C; 97% at 0.25C	94% at 0.5C; 97% at 0.25C
Cycle life	20,000 cycles at 0.5C	20,000 cycles at 0.5C
Cell temperature range	-40 C to +80 C	-40 C to +80 C
Electronics temperature range	-20 C to +60 C	-20 C to +60 C
Module ingress protection	IP40	IP40

Protection and interfaces

Contactor and fused disconnect protection | Smart touchscreen | Fault, Enable and Acknowledge interlocks
CAN bus, RS485 and TCP communications | Modbus RTU, Modbus TCP, Profibus, Profinet and EtherCAT options
Optional wired or Wi-Fi connectivity and front-access terminals

Protocol availability and final performance values are subject to manufacturer confirmation.