



# Q-SMEC USE CASES

## NAICS 2211 — ELECTRIC POWER GENERATION, TRANSMISSION & DISTRIBUTION

Quantum-anchored materials design for energy storage, grid-scale magnetics, sensing, and resilient operational technology — custom-engineered to End User target specifications.

NIKET Q-SMEC – VALIDATED TRL/MRL LEVEL 3 APPLICABILITY TO ELECTRIC POWER SECTOR USE CASES

### THE Q-SMEC MATERIALS DEVELOPMENT FRAMEWORK

/ 01

#### 22-Layer Technology Stack

Q-SMEC (Quantum Superconducting Magnetic Energy Containment) enables custom design of advanced materials in layered architectures.

/ 02

#### Orders-of-Magnitude Performance

Performance characteristics several orders of magnitude better than current state-of-the-art alternatives, built to End User provided target specifications.

/ 03

#### TRL / MRL Maturation Model

NIKET matures a customized material through Non-Recurring TRL/MRL Levels 3–5 on internal/partner funding, and Levels 6–9 in close coordination with the Industry End User.

## 01 1–100 MW Q-SMEC MODULAR SOLID-STATE BESS

**High-density, ultra-safe solid-state energy storage enabling low-cost substation buffering and microgrid resilience.**

- **CapEx advantage:** targets \$55–\$68/kWh installed cost, undercutting conventional utility-scale lithium-ion.
- **Extreme density:** delivers 450–600 Wh/L volumetric and 225–250 Wh/kg specific energy density.
- **Compact form factor:** 250 kW modules weigh 18–20 kg (55 × 35 × 20 cm) for rapid field deployment.
- **Lifespan & safety:** >20,000 hours continuous operation (–35 °C to +50 °C), NFPA 855 compliant.

**KEY SPECS** \$55–\$68/kWh installed • 1h / 2h / 4h / 8h configurations • >10,000 W/cm<sup>2</sup> dissipation • NFPA 855



## 02 Q-SMEC ALTERNATIVE TO GOES FOR TRANSFORMERS

**Next-generation soft magnetic material replacing grain-oriented electrical steel to eliminate lamination losses and reduce mass.**

- **Ultra-low core loss:** 0.6–0.7 W/kg under high induction permeability ( $B_g \geq 1.9$  T at 50/60 Hz).
- **High saturation:** >2.5 T saturation induction ( $B_{sat}$ ) with peak permeability >14,000.
- **Stacking efficiency:** >97% of theoretical maximum, eliminating interlaminar insulation coatings.
- **High-temp stability:** Curie temperature 770–800 °C with thermal expansion <100 nm/cm/°C.

**KEY SPECS** 0.18–0.35 mm thicknesses •  $B_{sat} > 2.5$  T • >97% stacking factor • current / power / distribution

## 03 Q-SMEC SUBSTATION, SCADA & DATA CENTER SENSOR SUITE

**Multi-modal quantum sensor network for direct electromagnetic field measurement and switchgear prognostics.**

- **Direct field sensing:** direct E-field, B-field and rate of change (dB/dT).
- **Grid telemetry:** voltage, current, power, flow, pressure, temperature, vibration, fault detection, grid asset and load monitoring, solar/wind.
- **Switchgear PHM:** prognostics & health management developed with Data Thermal / The Sensor Group.

**KEY SPECS** substation • SCADA • data center • advanced metering infrastructure

## 04 Q-SMEC OPTIMIZED SMART METER

**Utility-grade metering platform with ten embedded sensors, Q-SMEC storage power and post-quantum encryption.**

- **Waveform streaming:** 5–15 kHz V/I samples across up to 256 channels for NILM load disaggregation.
- **Embedded sensors:** temperature (2), voltage (2), power (2), pressure (2), arc (1), tilt (1).
- **Communications & security:** 5G / ISM 902–928 MHz / 2.4 GHz with post-quantum cryptography and inherent anti-tamper design.

**KEY SPECS** ANSI C12.20 • 120–480 V  $\pm 0.1\%$  • front / mid-level / backhaul • –40 to 85 °C • <5 W burden

## 05 DEPARTMENT OF WAR-GRADE PQC OT / NERC CIP CYBERSECURITY

Quantum-resistant operational technology cybersecurity engineered to protect critical grid infrastructure (NERC CIP).

- **Post-quantum cryptography** deployed across OT assets, SCADA control systems and substation networks.
- **Pilot basis:** TEP and SRP Cyber Resilience Pilot Proposals (34 pages each), available on request.
- **Co-developed with** Blue Ridge Networks Inc, High Entropy Security Inc and Black Fur Inc.

IN COORDINATION WITH:

BLUE RIDGE NETWORKS INC

HIGH ENTROPY SECURITY INC

BLACK FUR INC

## 06 WARGA-DESIGN FIRE-TUBE STEAM / HOT-WATER BOILER

Patented thermal boiler technology delivering 50% heating-surface reduction and optimized flue-gas exchange.

- **Proven history:** 25+ year track record of operational reliability at Tucson Medical Center.
- **Efficiency:** eliminates the drawbacks of 2/3/4-pass wetback and dryback boilers via pressurized-door furnace optimization.
- **Cost savings:** 50% reduction in heating surface area cuts acquisition, installation, operation and maintenance costs.

**KEY SPECS** fire-tube steam / hot-water · pressurized-door furnace · optimized tube configuration · partial-load efficiency



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