VR Engineering mastering smart grid and IoT integration in electrical control systems

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VR Engineering and Consultancy Services (VRECS) is the frontrunner in supporting grid stability. Amit Varshney discusses more with EPR.

How is VRECS integrating interoperable control panels and smart metering for efficient grid operations?

At VRECS, we recognise that the future of distribution lies in seamless interoperability between control infrastructure and smart metering systems. Over two decades of experience have taught us that passive panel design is obsolete; modern substations must actively participate in the grid's intelligence layer.

Our current generation of control panels incorporates native support for DLMS/COSEM protocols, which have emerged as the global standard for AMI communication. We have architected our RTUs and gateway modules to support multiple protocol stacks simultaneously—Modbus TCP/RTU, IEC 61850, DNP3, and MQTT that ensure backward compatibility with legacy SCADA systems while enabling modern IoT cloud connectivity. The panels feature a dual-Ethernet architecture with protocol translation engines that can ingest high-frequency meter data (15-minute to real-time) and convert it into actionable substation-level insights.

We are particularly focused on edge intelligence. Rather than merely forwarding raw meter data, our panels preprocess AMI streams to detect load imbalances, power-quality disturbances, and consumption anomalies at the feeder level before transmitting summarised telemetry upstream. This approach dramatically reduces bandwidth requirements while enabling utilities to respond to local faults faster. For solar rooftop and EV charging deployments, we have implemented bi-directional energy accounting that reconciles generation, consumption, and grid export data across multiple meter endpoints in real time.

Our validation methodology involves extensive field pilots. We currently have three active deployments with regional DISCOMs where our panels aggregate data from 500+ smart meters per feeder that demonstrate stable operation under diverse communication conditions, including intermittent connectivity scenarios common in semi-urban deployments.

How do VRECS help to reduce losses and anticipate failures in Indian grid conditions?

Predictive intelligence represents the convergence of our panel manufacturing heritage and emerging software capabilities. We have developed a hybrid edge-cloud analytics framework specifically designed for Indian grid conditions, where connectivity reliability varies significantly.

At the edge within our panels, we have deployed lightweight machine learning models running on industrial-grade ARM processors. These models perform real-time analysis of current harmonics, voltage transients, thermal signatures from integrated sensors, and switching patterns to predict component failures 72-96 hours in advance. Our algorithms were trained on datasets from our own 20-year service history, encompassing thousands of maintenance events across diverse environmental conditions. The edge analytics also implement fast anomaly detection for theft and bypass scenarios, comparing feeder-level consumption patterns against historical baselines with sub-second latency.

The cloud layer, hosted on secure, utility-grade infrastructure, performs deeper analytics, including correlation of weather data with load profiles, seasonal demand forecasting, and loss-attribution models that distinguish technical losses from commercial losses across distribution networks. Our validation protocol is rigorous. We maintain parallel operations for six months, comparing AI predictions against actual maintenance logs and manually detected anomalies. Current accuracy metrics show 87 percent

prediction reliability for equipment failures and 82 percent accuracy in automated theft detection with continuous improvement through feedback loops.

To reduce losses, we have integrated energy balance analytics that reconcile substation metering, DT-level measurements, and consumer meters, pinpointing loss concentration zones with 500-meter accuracy to enable focused field interventions.

How does your company helps to protect large-scale utility infrastructure from evolving OT and IT threats?

With over 20 years witnessing the evolution from isolated electromechanical systems to interconnected digital infrastructure, I understand that cybersecurity is not optional, it is foundational. Our approach implements defence-in-depth across four layers.

First, our panels incorporate hardware-based security: TPM 2.0 modules for cryptographic key storage, secure boot chains that prevent unauthorised firmware execution, and physical tamper detection. Network architecture follows strict segmentation—operational technology networks remain isolated from IT networks through industrial firewalls with protocol-aware deep packet inspection.

Second, we implement certificate-based mutual authentication for all remote connections, with rotating credentials and mandatory VPN tunnels for any external access. Our remote monitoring modules support role-based access control with comprehensive audit logging every configuration change, firmware update, and data access is permanently recorded with cryptographic timestamps. Firmware management follows a controlled deployment pipeline: updates are digitally signed, tested in sandbox environments replicating field conditions, and deployed in phased rollouts with automatic rollback capability if anomalies are detected. We have established secure update channels using HTTPS with certificate pinning, and for large-scale utility deployments, we support over-the-air update orchestration with scheduling algorithms that prevent simultaneous updates across critical substations. For utilities deploying 100,000+ smart meters, we provide centralised key management systems integrated with our panels, ensuring end-to-end encryption for AMI data flows. We conduct annual third-party penetration testing and maintain compliance with IEC 62443 industrial cybersecurity standards.

How do sensorised cables and DTS integration enable predictive fault detection and precise localisation in underground distribution networks?

Sensorised cables represent a transformative opportunity moving from reactive "find the fault" approaches to proactive condition monitoring. Our current distribution designs incorporate standardised interfaces for cable-mounted distributed temperature sensing (DTS) and partial discharge monitoring systems. We have developed integration modules that interface with fiber-optic DTS systems using industry-standard protocols, providing real-time thermal profiles along cable routes with 1-meter spatial resolution. The panels correlate thermal data with load currents and ambient conditions to distinguish between normal operational heating and anomalous hotspots indicating connection degradation or insulation breakdown.

For fault location, we have implemented traveling-wave-based algorithms in our protection relays that timestamp fault transients with microsecond precision. When integrated with smart cable sensors, this enables fault localisation within 50-100 meters on cables up to 10 kilometers—a dramatic improvement over traditional impedance-based methods. The telemetry architecture supports IEC 61850-9-2 sampled values for synchronised measurements across multiple monitoring points. Our proposed interface standard uses Modbus TCP for sensor data aggregation, with

RESTful APIs for integration with utility GIS and outage management systems. We are currently piloting smart cable integration in three underground cable networks, validating the correlation between DTS alerts and actual cable failures. Preliminary results show 78 percent of thermal anomalies precede failures by 2-6 weeks, enabling preventive replacement.

How does embedding BIS and IEC compliance in design enable scalable, interoperable smart-grid deployments across utilities?

Compliance is not merely regulatory checkbox, it is the foundation of scalable, interoperable infrastructure. With experience spanning CEA regulations, BIS standards evolution, and IEC harmonisation, we have embedded compliance into our design DNA.

All our panels undergo mandatory BIS certification, with designs conforming to IS 8623 (AC metal-enclosed switchgear), IS 13947 (LV switchgear assemblies), and IEC 61439 series. For protection and control, we implement IEC 61850 for substation automation, ensuring semantic interoperability and not just protocol compliance. Our engineering teams maintain active participation in BIS committee meetings, allowing us to anticipate standard revisions and maintain forward compatibility. For utility interoperability, we have developed configurable information models that map to common DISCOM requirements across multiple states each with unique technical specifications. Our panels support utility-specific communication profiles while maintaining core functionality portability.

Reference deployments include: a 33/11kV substation automation project for a northern DISCOM integrating 20+ substations with centralised SCADA; solar rooftop portfolio management for a 50MW distributed generation network with real-time curtailment control; and an ongoing smart meter aggregation pilot processing data from 2,000+ meters across urban feeders. We have also collaborated with aggregator platforms for EV charging infrastructure, implementing OCPP 2.0.1 compliance for load management and dynamic tariff integration.

Our commitment extends beyond installation, we provide training programmes covering operational aspects, functional testing procedures, and troubleshooting protocols, ensuring utility staff can fully leverage smart-grid capabilities. This holistic approach, combining two decades of field experience with forward-looking innovation, positions VRECS as a trusted partner for India's grid modernisation journey.

MECO launches 108P+ TRMS a compact precision redefined for everyday electrical testing

MECO proudly introduces the NEW 3⅝ Digits, 6000 Counts Pocket-Size Auto-Ranging Digital Multimeter (Model: 108P+ TRMS). A compact yet powerful instrument engineered for precision, reliability, and everyday convenience. Featuring a bright LCD backlight display, this multimeter delivers accurate measurements across a wide range of electrical parameters, making it an ideal companion for both professionals and hobbyists. Despite its small size, the MECO 108P+ TRMS offers an impressive measurement range. It accurately measures AC/DC voltage up to 1000 V, current up to 10 A, and resistance up to 60 MΩ, ensuring suitability for both low-level electronics and high-voltage industrial applications. Advanced functions such as capacitance measurement up to 9.999 mF, frequency measurement up to 10 MHz, and duty cycle from 0.1% to 99.9% extend its usability across complex electrical and electronic systems. The inclusion of temperature measurement from –20°C to 1000°C further enhances its utility in maintenance and diagnostics.

A key highlight of the 108P+ TRMS is its True RMS (TRMS) capability, which ensures accurate readings even on non-linear and distorted waveforms—an essential requirement in modern power systems and inverter-based applications.

Special features

User-friendly features such as REL Δ (relative measurement), non-contact voltage (NCV) detection, LIVE test, data hold, and audible continuity and diode testing simplify troubleshooting and improve safety on site. The bright LCD with backlight ensures clear visibility in low-light environments, while auto power-off and low battery indication support efficient, worry-free operation.

Included accessories

Supplied with test leads, a carrying case, a K-type thermocouple, and a pre-installed battery, the MECO 108P+ TRMS is ready to use straight out of the box. This versatile instrument is essential for a wide range of applications, including Electronic Component Testing, Industrial Maintenance, Automotive Diagnostics, HVAC Servicing, Solar Systems, Railways, Elevators and Escalators, Telecom and many more. Its compact size, robust performance, and TRMS capability make it a dependable choice for technicians and engineers across diverse fields.

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