

1. Role of the IntelliNeo 6000 in the Technoserve Microgrid Architecture

In the proposed Technoserve system, the **IntelliNeo 6000** is not a power-conversion device and does not replace inverters, protection relays, or switchgear. Its role is more fundamental:

it is the supervisory and coordinating controller that determines *how* and *when* each energy asset is allowed to operate together as one electrical system.

According to ComAp's own definition, the IntelliNeo 6000 is a *microgrid controller for parallel hybrid microgrid applications*, designed to coordinate:

- Battery Energy Storage Systems (BESS),
- Renewable generation such as PV,
- Utility mains connections, and
- Conventional generators (when used in MINT architectures).

In your case, with **existing generators, existing PV, and a new BESS**, the controller would be deployed in a **MINT (Multiple Island-Parallel)** configuration. This is the architecture explicitly intended for systems where **multiple source types operate together and must remain stable if any single source connects or disconnects**

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The controller continuously measures:

- Bus voltage, frequency, phase sequence, and harmonic distortion,
- Active and reactive power flows,
- State of charge (SOC) and operating limits of the BESS,
- Status and availability of breakers and sources.

Based on these measurements, it executes pre-defined control strategies that govern **power sharing, import/export limits, islanding behaviour, and recovery after disturbances**.

2. Integration with Existing Electrical Infrastructure

2.1 Electrical Interface Philosophy

The IntelliNeo 6000 integrates into existing infrastructure through **measurement, control, and communication layers**, not by altering the fundamental protection philosophy of the plant.

Electrically, it connects to:

- **Voltage transformers (VTs)** on the BESS side and the mains/bus side,
- **Current transformers (CTs)** for BESS output and auxiliary (bus/mains) measurements,
- **Breaker status feedbacks** (MCB, BCB, PVCB as applicable),
- **Breaker control outputs**, where allowed by the design.

Importantly, the controller **does not bypass or override hardwired protections**. All fast fault clearing (short-circuit, earth fault, inverter self-protection) remains the responsibility of:

- Inverter internal protections,
- Generator controllers,
- Protection relays and switchgear.

The IntelliNeo 6000 operates **above this layer**, ensuring that sources are only commanded to operate *within allowed electrical conditions*.

2.2 Integration of the BESS (CATL + EPC CAB 1000)

The controller natively supports **one BESS per IntelliNeo 6000**, with explicit internal logic governing:

- BESS starting sequence,
- DC precharge (stabilisation),
- Grid-following and grid-forming operation,
- Active and reactive power control,
- SOC-based charging and discharging limits.

A key function for client confidence is the **explicit BESS state machine**, which controls how the battery transitions between states such as:

- Standby,
- Charging,
- Discharging,
- Grid-forming (island operation),
- Fault or inhibited states.

This is not a “best-effort” behaviour; it is a defined sequence described in the application functions section of the manual, ensuring that the BESS is **never connected to the bus in an electrically unsafe state**

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The controller supports both:

- **P-Q control**, where active and reactive power are directly commanded, and
- **U-f control**, where the BESS forms voltage and frequency in island mode.

Which method is used depends on:

- Whether the system is grid-connected or islanded,

- Whether the BESS inverter supports grid-forming operation.
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2.3 Existing PV Integration

Existing PV inverters are integrated via:

- **Modbus RTU or Modbus TCP** communication, or
- Discrete breaker control and power measurement.

The IntelliNeo 6000 supports:

- PV output limitation (curtailment),
- Priority use of PV generation ahead of gensets or mains import,
- PV disconnection during islanding if grid-code or inverter limitations require it.

Importantly, the controller **does not assume PV is always controllable**. If PV inverters only support on/off control or limited power setpoints, the system logic is configured accordingly. This avoids the false impression that the controller can “force” behaviour that the inverter cannot support

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2.4 Existing Generators

In a MINT configuration, generators retain their **own dedicated genset controllers**. The IntelliNeo 6000 coordinates with them via:

- CAN inter-controller communication, or
- Modbus communication.

This distributed architecture ensures that:

- Loss or trip of a generator does **not collapse the microgrid control system**,
 - Each source remains locally protected,
 - Power sharing and load control are coordinated rather than centralized in a single point of failure.
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3. Power Management and Operating Modes

3.1 Operating Modes (On-Grid and Off-Grid)

The IntelliNeo 6000 explicitly distinguishes between:

- **On-grid operation** (parallel with utility mains), and
- **Off-grid (islanded) operation**.

Transitions between these states are managed through:

- Loss-of-mains detection,
- Controlled disconnection and reconnection logic,
- Synchronisation checks before reconnection.

The controller supports **black-start scenarios**, provided the BESS inverter itself is capable of grid-forming operation. In such cases, the IntelliNeo 6000 ensures:

- Controlled energisation of the bus,
- Gradual load pickup using ramped power increases,
- Coordination of PV and genset reconnection after stabilisation

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3.2 Energy Optimisation Functions

The following functions are **explicitly supported and configurable**:

- **Balance mode**
Prioritises renewable generation and BESS use before importing from mains or starting gensets.
- **Peak shaving**
Limits import from the utility grid by supplementing demand with BESS power.
- **Load shedding**
Ensures critical loads remain supplied when available generation is insufficient.
- **Import / Export control**
Maintains grid exchange within contractual or technical limits.

These are not “AI-driven” or adaptive in an uncontrolled way. They are **rule-based strategies** with clearly defined setpoints and limits configured during commissioning.

4. Reliability, Redundancy, and Cybersecurity

4.1 Redundancy and Fault Tolerance

The IntelliNeo 6000 supports:

- **Hot-swap controller redundancy**, where a secondary unit can take over if the primary fails,
- **Redundant CAN communication lines**, reducing single-point failures in inter-controller communication.

In addition, the controller maintains:

- Event-based history logs,
- CAN bus diagnostic logs,
- Alarm histories with time stamping.

This significantly reduces troubleshooting time and improves operational transparency

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4.2 Cybersecurity and Access Control

The controller is designed in alignment with **ISA 62443 security principles**, including:

- User-based access levels,
- Encrypted controller data,
- Protected PLC logic and setpoints,
- Separation of trusted and untrusted network interfaces.

Remote access via **AirGate 2.0** allows monitoring and control **without exposing the site to direct public IP addressing**, reducing attack surface while enabling remote support and fleet management

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5. Why the IntelliNeo 6000 Is Central to the Solution

From a system perspective, the IntelliNeo 6000 is best understood as the “**system conductor**”:

- Inverters convert power,
- Batteries store energy,
- Generators produce energy,
- Switchgear protects equipment,

but **only the microgrid controller decides how all of these elements are allowed to interact safely and efficiently.**

Without a controller of this class:

- Islanding becomes risky or manual,
- Power sharing becomes unstable,
- Renewable utilisation drops,
- Recovery after faults becomes slower and more error-prone.

The IntelliNeo 6000 does not remove engineering responsibility or eliminate the need for correct protection design—but it **enables a complex hybrid system to behave as one coherent electrical plant rather than a collection of independent assets.**

Final reassurance to the end user

The controller **does not promise uninterrupted power under all circumstances**, nor does it override physical protections. What it does provide—when correctly engineered and commissioned—is:

- Predictable behaviour,
- Coordinated response to disturbances,
- Transparent control logic,
- Compliance with recognised electrical and grid standards.

For a hybrid BESS-PV-genset installation such as Technoserve's, it is not an optional accessory; it is the **enabling layer that makes the solution technically viable and operationally understandable.**