Electrical & Power Control Interfaces

AOFS defines the electrical and power control architecture to **safely operate pumps, valves, and irrigation loads** under any power source. It is designed to **ensure fail-safe operation, energy efficiency, and compliance with AOFS standards**, independent of whether the farm uses grid, generator, or solar power.

1. Core Power Principles

- AOFS is **power-source agnostic**: it works with grid, generator, solar, or hybrid systems.
- Controllers must enforce **fail-safe operation** for irrigation and actuation regardless of the power source.
- Systems must support **safe shutdowns** in case of power anomalies or failures.
- AOFS may track **energy consumption of pumps and actuators** to support optional logging, reporting, and operator awareness.
    - *Recommended for off-grid or weak-grid farms, but not required **for farms with stable grid power. ===== 2. Optional Solar Integration ===== AOFS supports optional solar monitoring for farms that want to optimize energy usage: *** Level 1 – Minimal Monitoring (Recommended for off-grid / weak-grid farms) ***** **Field Controllers may monitor battery voltage and current. * Supports reliable irrigation operation when solar/battery power is used. * Fully optional for farms with stable grid or generator power. *** Level 2 – Integrated Monitoring (Optional Advanced Module) ***** **Controllers can read solar generation metrics from panels/inverters via standard protocols (e.g., Modbus, MQTT, RS485). * Enables dynamic irrigation scheduling based on energy availability. * Supports advanced PUE analytics and reporting. * Completely optional — AOFS compliance does** not depend **on it. ===== 3. Optional Energy-Aware Operation ===== * AOFS controllers** may **measure power consumption of pumps, valves, and other actuators while running. * Controllers** may **estimate battery drain or energy availability for upcoming scheduled irrigation events. * AOFS supports** event prioritization**: * Each scheduled irrigation or actuator event can be assigned an** urgency or importance level **by operators. * If insufficient energy is available: * Low-priority events can be** delayed or skipped**. * High-priority events are executed** as soon as sufficient energy is available**. * Optional alerts notify operators of skipped or delayed events. * All energy measurements, prioritization decisions, and resulting operational logs** may be recorded **for later analysis: * Enables visualization of energy usage and event execution history. * Helps operators determine if additional batteries, solar panels, or load rescheduling are needed. ===== 4. Implementation Guidelines ===== * AOFS compliance does** not require any specific power source, monitoring, or energy-aware operation**. * Optional monitoring modules should follow AOFS** data logging and offline-first principles**. * All controllers and modules, regardless of power source,** must enforce local fail-safes** for pumps, valves, and critical irrigation operations.

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