

DESIGN CONSIDERATIONS OF ENERGY MANAGEMENT SYSTEMS FOR AUSTRALIAN CONDITIONS

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EVOLVING ROLE OF EMS

- Shift from generation cost → system integration challenge.
- Control to coordination: renewables, fossil generators, batteries, and loads.
- Core EMS functions: forecasting, scheduling, optimization, cybersecurity.
- Autonomous operation and optimization.

Rack-mounted EMS for Generation Management



ON-GRID VS OFF-GRID EMS FOCUS

On-Grid EMS	Off-Grid EMS
Maximise renewable integration	Maintain autonomy & reliability
Ensure grid resilience & stability	Ensure stability with multiple DERs
Participate in market services (DR, FCAS)	Support black start & fault recovery
Comply with grid codes	Reduce fossil fuel use and O&M cost
Emphasis: Economics	Emphasis: Resilience

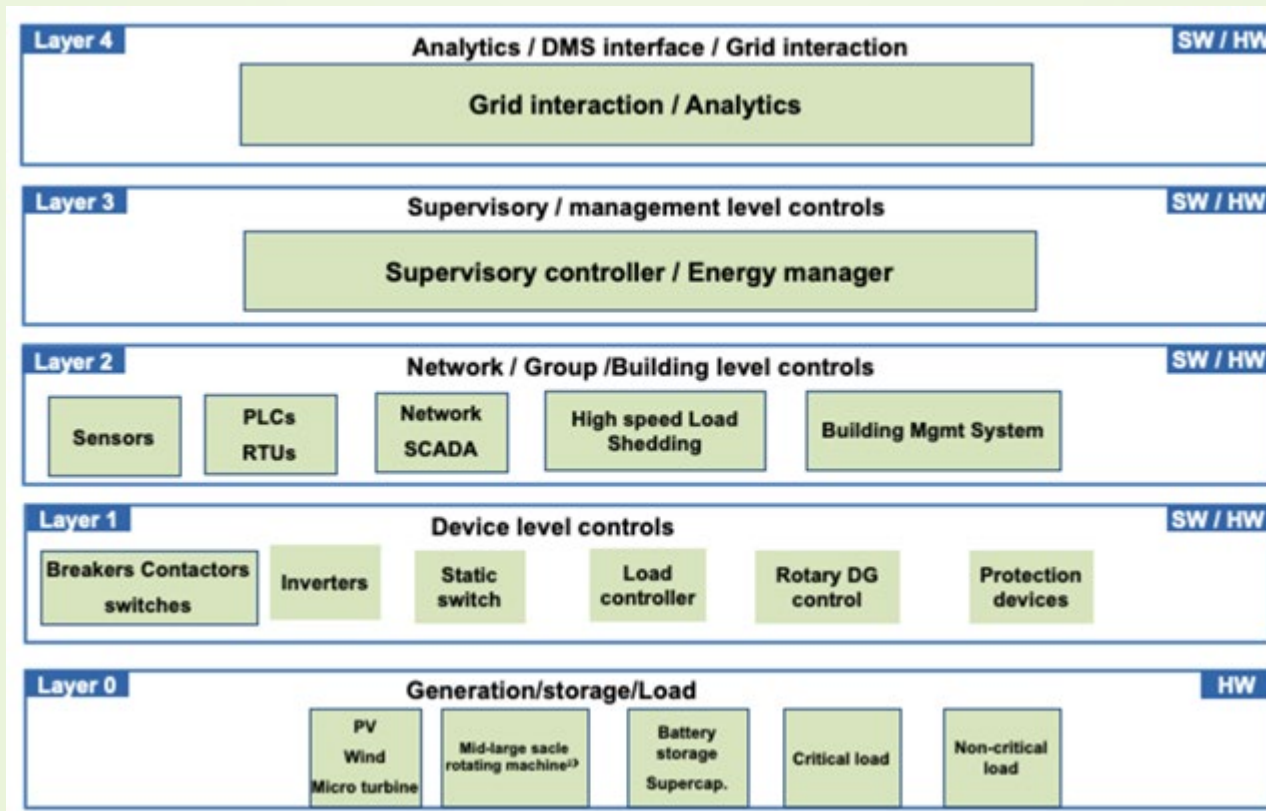
HIERARCHIAL EMS STRUCTURE

Based on NREL/Sandia/EPRI hierarchy

Level 1: Device-level (inverter, battery, generator)

Level 2: System Level, Microgrid controller (EMS/MMCS)

Level 3: Grid or DERMS interaction



IEC 62898 ARCHITECTURAL FRAMEWORK

IEC 62898-3-4 (2023) — Technical Requirements for Energy Management Systems (EMS)

This is the **latest and highly relevant** standard for developers of **Energy Management Systems** in microgrids.

- MEMS: Energy Management (supervisory scheduling, forecasting)
- MMCS: Monitoring & Control (real-time control)
- Supports: grid-connected, islanded, and hybrid operation.

For smaller systems the two functions are usually combined in one unit

AUSTRALIAN CONTEXT & GAPS

Reality:

- Remote sites, not easily accessible
- No on-site maintenance staff
- High temperature, dust

Off-grid weaknesses:

- Lack of true black-start, sequencing
- Poor fault recovery
- Over dependence on remote communication

Hardware:

- Redundancy
- AC UPS for controls is impractical. Usually the weakest link.

Software:

- Modular software for the ease of customization, maintenance
- Auto fault detection and recovery
- Must keep operating in a safe mode if remote communications fail

Serviceability and Safety:

- Controls fully isolated from high voltage circuits

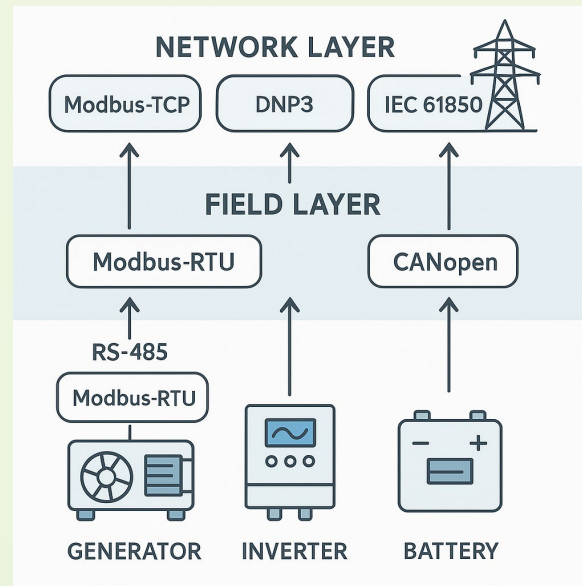
MODULAR AND MAINTAINABLE DESIGN

- Modular control blocks, tool-free servicing by local electrician
- Embedded diagnostics and predictive maintenance.
- Self-learning EMS from cross-site performance.



COMMUNICATION & INTEROPERABILITY

- Field layer: RS-485 / CAN (Modbus-RTU, CANopen)
- Network layer: Ethernet (Modbus-TCP, DNP3, IEC 61850)
- Supports centralized, distributed or hybrid control.



CYBERSECURITY AND STANDARDS ALIGNMENT

This is still under appreciated. Needs greater focus.

- Global reference: **NERC CIP**.
- IEC 62351 & 61850-8 security layers.
- **EPRI–CSIRO** have been collaborating to develop guidelines for Australian conditions.

LESSONS LEARNED & FUTURE DIRECTION

- EMS integrated with PCS are usually limited to Level 1 control.
- Imported EMS often do not meet environmental, reliability and serviceability requirements.
- Generic EMS have limited customization capabilities to suit Australian conditions.
- Opportunity: locally built, IEC-compliant, serviceable EMS platform.
- AI-driven EMS offers emerging potential for auto configuration and real-time optimisation in BESS and microgrids.

SUMMARY & CLOSING

- IEC 62898 defines a global EMS framework.
- Key to success: modularity, cybersecurity, resilience, serviceability.
- *Smart control — not cheap energy — is the next frontier.*

THANK YOU

Contact me if you wish to discuss further:

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