



Microgrid Design and Control Course: DER Sizing, Islanding and Protection



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Introduction:

Microgrid design and control, covering DER sizing, islanding and protection, is a 10-day course for power, utility, renewable and site energy engineers that ends with a Hybrid PV-BESS-Diesel Microgrid Specification for a remote case site. Organisations lose fuel savings and resilience when gensets, solar arrays and batteries are sized by rule of thumb, controllers cannot island or resynchronise cleanly and protection settings ignore the low fault current of inverter-based sources. Nominees already design, commission or operate electrical systems and work through modelling builds on load, resource and dispatch data. CoreConcept Training Center delivers this microgrid design and control course.

Course Objectives:

- Select an AC, DC or hybrid microgrid architecture and DER mix that matches a site's critical loads, resources and resilience target
- Build hourly load profiles and resource datasets and run hybrid optimisation software to size PV, wind, BESS, gensets and CHP on net present cost
- Specify grid-forming and grid-following inverter roles, droop settings and a microgrid controller against IEEE 2030.7 functions
- Design planned and unplanned islanding transitions, resynchronisation and a black start sequence for an islandable microgrid
- Coordinate protection for low inverter fault current and verify interconnection behaviour against IEEE 1547 requirements
- Evaluate ownership models, tariffs, power quality and operating KPIs to prepare a microgrid business case and O&M plan

Target Audience:

- Power system engineers responsible for designing and studying distribution-level microgrids and hybrid plants
 - Utility engineers responsible for assessing DER interconnection requests and microgrid operating protocols
 - Renewable energy engineers responsible for adding storage and controls to solar and wind installations
 - Site energy engineers responsible for power supply at mines, campuses, industrial plants and island facilities
 - Commissioning and operations engineers responsible for microgrid controllers, inverters and genset fleets
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Course Outline:

Day 1: Microgrid Concepts, Architectures and Use Cases

- IEC Microgrid Definition, Electrical Boundary and Point of Common Coupling
- AC, DC and Hybrid AC/DC Bus Architecture Selection
- Grid-Connected, Islandable and Permanently Isolated Microgrid Operating Types
- Use Case Profiles for Remote Mines, Islands, Campuses and Plants
- Resilience Value of Critical Load Supply During Utility Outages

Day 2: DER Technologies and the Microgrid Standards Landscape

- PV Array and Wind Turbine Output Behaviour in Small Systems
- Diesel and Gas Genset Minimum Loading and Fuel Curves
- CHP Units with Heat Recovery for Industrial and Campus Sites
- BESS Inverter Ratings, Usable Energy and Cycling for Microgrids
- IEEE 1547, IEEE 2030.7 and IEC Microgrid Standards Map

Day 3: Load Profiling and Resource Assessment

- Hourly Load Profile Construction from Metering and Audit Data
- Critical, Priority and Sheddable Load Classification Matrix
- Peak Demand, Load Factor and Motor Starting Surge Assessment
- Solar Irradiance and Wind Speed Datasets for Sizing Inputs
- Fuel Logistics, Delivered Diesel Price and Storage Autonomy Review

Day 4: Sizing Tools and Techno-Economic Optimisation

- Hybrid Optimisation Software Set-Up with Component Search Space
- Load Following versus Cycle Charging Dispatch Strategy Comparison
- Net Present Cost, LCOE and Renewable Fraction Outputs
- Sensitivity Runs on Fuel Price, Load Growth and Capex
- Operating Reserve, Spinning Margin and Unmet Load Constraints

Day 5: Guided Case Study on Grid-Connected Campus Microgrid Sizing

- Case Campus Load and Tariff Data Pack Review
 - Candidate PV, CHP and BESS Mix Optimisation Runs
 - Optimal Configuration Ranking by Net Present Cost
 - Islanded Autonomy Check for Critical Campus Loads
 - Week-One Sizing Note with Assumptions and Sensitivities
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Day 6: Inverter Control and the Microgrid Control Hierarchy

- Grid-Forming versus Grid-Following Inverter Control Behaviour
- Frequency-Watt and Voltage-VAR Droop for Load Sharing
- Virtual Synchronous Machine Control and Synthetic Inertia Settings
- Secondary Frequency Restoration and Tertiary Economic Dispatch Layers
- IEEE 2030.7 Microgrid Controller Functions and Dispatch Modes

Day 7: Islanding Transitions, Protection and Interconnection Requirements

- Planned and Unplanned Islanding Transition Sequences and Timing
- Synchronism Check and Resynchronisation to the Utility Feeder
- Microgrid Black Start Sequence from a Grid-Forming BESS
- Adaptive Protection Settings for Low Inverter Fault Current
- IEEE 1547 Ride-Through and Anti-Islanding Verification Tests

Day 8: Communications, Business Models and Stakeholder Agreements

- Microgrid SCADA Architecture with IEC 61850 and Modbus Links
- Cybersecurity Zoning for Microgrid Controller Networks
- Energy-as-a-Service, PPA and Owner-Operated Microgrid Models
- Standby Charges, Demand Charges and Export Tariff Structures
- Utility Interconnection Agreement and Operating Protocol Negotiation

Day 9: Power Quality, Island Stability and Operations KPIs

- Harmonic Distortion and Voltage Unbalance in Inverter-Dominated Islands
- Frequency Nadir and Small-Signal Stability Checks in Island Mode
- Genset Run Hours, Fuel Consumption and Diesel Displacement KPIs
- Preventive Maintenance Plan for Inverters, Batteries and Gensets
- Microgrid Performance Dashboard with Availability and Renewable Fraction

Day 10: Modelling Build Capstone on a Remote Site Hybrid Microgrid

- Remote Site Load, Solar and Fuel Data Brief
 - PV-BESS-Diesel Sizing Run with Dispatch Strategy Selection
 - Control Philosophy and Islanding Protection Scheme Drafting
 - Life-Cycle Cost and Fuel Saving Business Case
 - Hybrid Microgrid Specification Completion and Peer Defence
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Skills You Will Gain:

- Microgrid Architecture Selection
- DER Mix Optimisation
- Load Profile Analysis
- Inverter Droop Tuning
- Islanding Transition Design
- Inverter-Based Protection Coordination
- Microgrid Business Case Modelling
- Microgrid Performance Monitoring

Why Attend This Course:

- Deliver a Hybrid PV-BESS-Diesel Microgrid Specification to the project sponsor and the engineering manager for approval
- Decide which genset, solar and battery ratings, dispatch strategy and controller functions a site actually needs
- Avoid oversized gensets, failed island transitions and protection that cannot see inverter faults before construction locks them in
- Share sizing models, droop settings and islanding test sequences with design, commissioning and operations colleagues

Conclusion:

Back at work, the participant presents the Hybrid PV-BESS-Diesel Microgrid Specification to the project sponsor, the engineering manager and the operations lead. They use it to approve the DER ratings and dispatch strategy, issue the controller and protection requirements to suppliers, and agree the interconnection protocol with the utility. After the first season of operation, the unit should compare fuel consumption, genset run hours, renewable fraction and islanding events against the modelled values and retune dispatch and protection settings where results diverge.

Frequently Asked Questions FAQ:

What should participants know before the microgrid design and control course?

Participants should already work with electrical distribution, protection or power plant equipment and read single-line diagrams. Familiarity with spreadsheets helps in the sizing work. Bringing anonymised load data or a single-line diagram from a site lets them test the methods on their own system.

How does microgrid design and control differ from a renewable energy plant course?

It treats the site as one controllable system that can island: DER sizing against local loads, inverter control, controllers, islanding, resynchronisation and protection. Renewable plant courses focus on utility-scale yield, layout and grid connection of a single generating plant.

Why do grid-forming inverters matter in microgrid design and control?

Grid-forming inverters set voltage and frequency when the microgrid is islanded, so the site can run with gensets off and support black start. Grid-following units only inject power into an existing waveform and cannot hold an island on their own.

What do participants take back from the microgrid design and control course?

Participants take back a Hybrid PV-BESS-Diesel Microgrid Specification covering load and resource data, sized DER ratings, dispatch strategy, control philosophy, protection approach and a life-cycle cost case, plus sizing and islanding checklists to reuse on other sites.