AMEREN MICROGRID

Owen Lock - Application Director

S&C ELECTRIC COMPANY

- 100+ years old, headquartered USA
- Global provider of electric power systems solutions
  - Fusing, switchgear, distribution automation, power quality
  - Power systems studies, laboratory & testing
  - EPC and asset management
- Asia Pacific HQ in Melbourne

MICROGRID AND ENERGY STORAGE PIONEERS

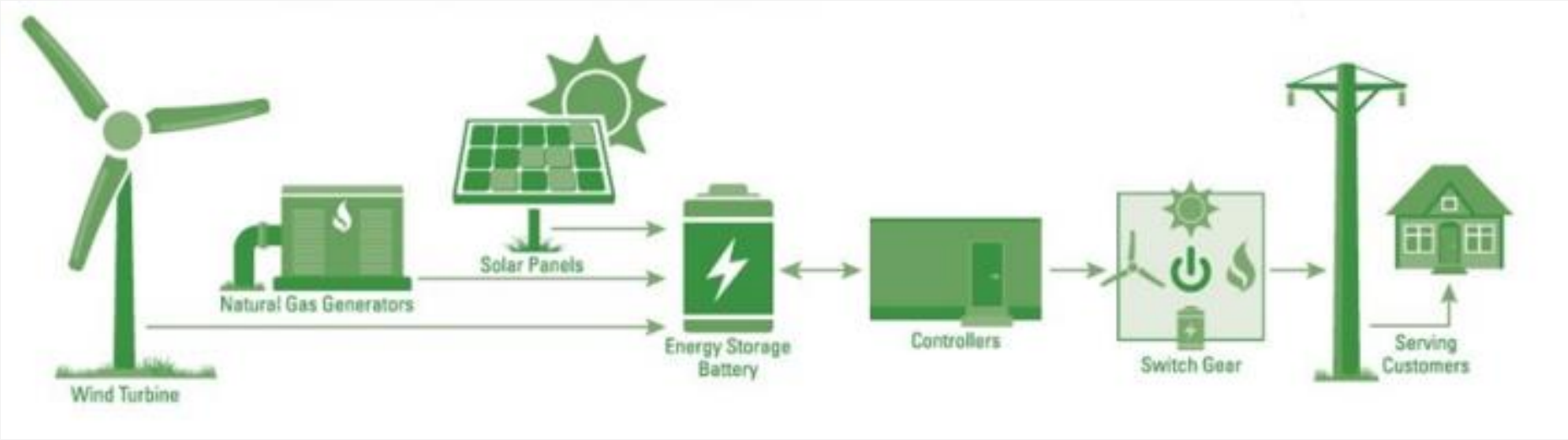
Project Name	Wind	Solar	Onsite Generation	Self-Healing	Energy Storage	Islanding
Dyess Air Force Base			■	■		■
Cyber Innovation Center				■	■	
IIT – Perfect Power	■	■	■	■	■	■
Catalina Island			■		■	■
Presidio 4MW				■	■	■
Xcel Energy	■			■	■	
NEDO		■			■	
Balls Gap				■	■	■
Santa Rita Jail MicroGrid	■	■	■	■	■	■
Coalition of the Willing		■	■	■	■	■
City of Golden - BC Hydro		■		■	■	■
PowerCor Australia		■		■	■	■
Oncor SOSF Microgrid	■	■	■	■	■	■
Ameren Microgrid	■	■	■	■	■	■

AMEREN MICROGRID

- 1MW microgrid
- Supplies distribution feeder
- 6 months of engineering and design
- 7 weeks of construction
- Commissioned October 2016

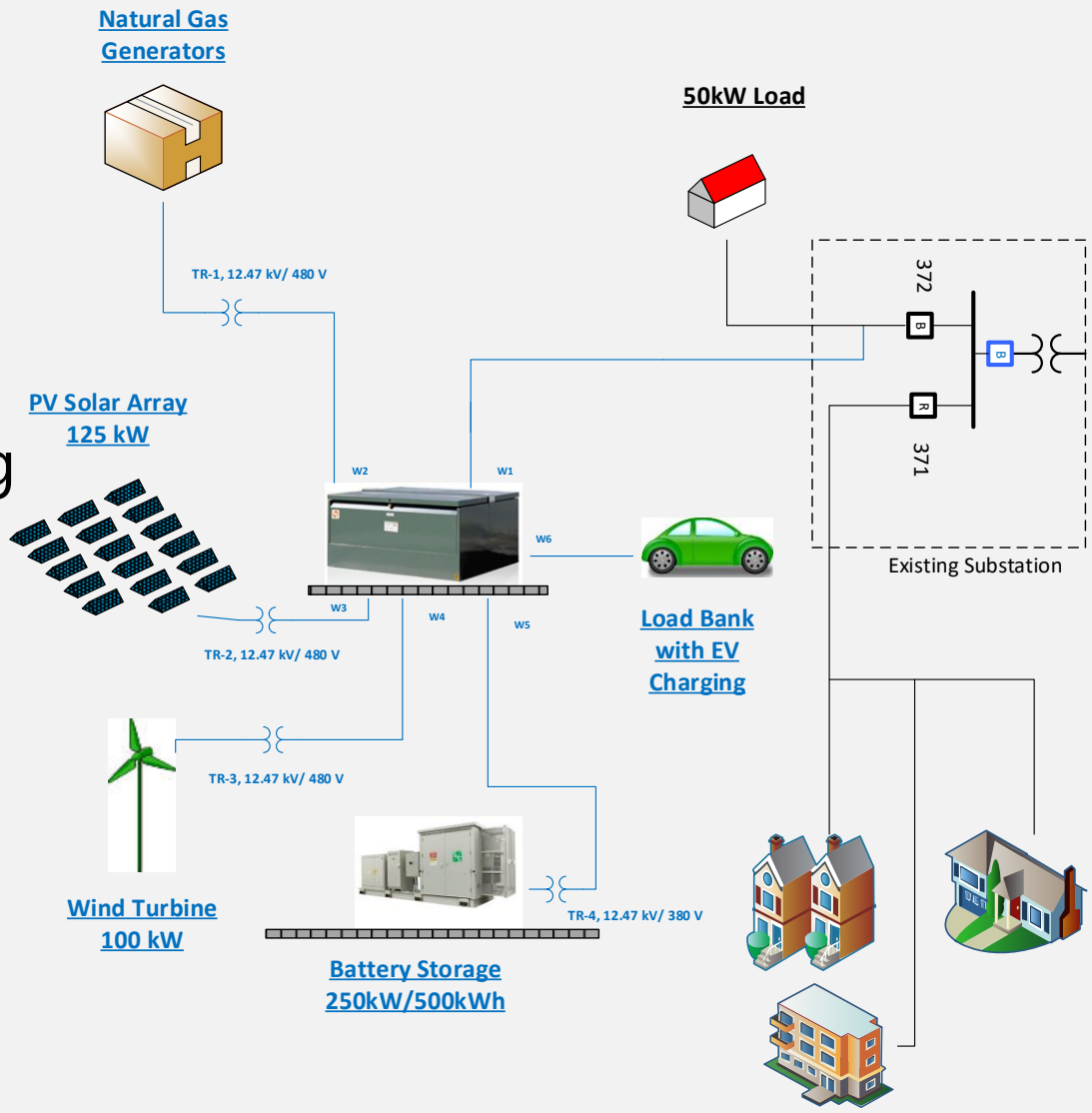
GROUND BREAKING

- Supply an entire “real-world” distribution feeder
- Seamless transitions –no reliability standards exemptions
- Transfers and prolonged operation with DER & BESS (no rotating generators in play)



EPC BY S&C

- Policy & regulation
- Design & engineering
- Business case delvellopment
- Construction
- Optimisation



GENERATION SOURCES

- 100kW wind
- 125kW PV
- 2x 500kW Gas Generators
- 250kW/500kWH Energy Storage

ENERGY STORAGE

- Microgrid backbone
- Voltage/frequency source
- Renewables optimisation
- Black start
- Smooth transitions

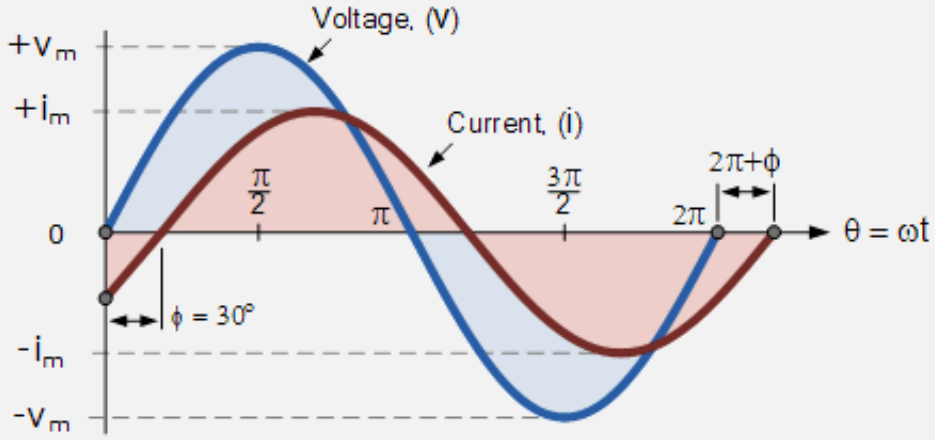
MICROGRID CONTROL HIERARCHY

PRIMARY

Performed by energy storage Power Conversion System (PCS) controller

Fast acting controls, often sub-cycle

- Provision of stable voltage source
- Frequency Control
- Volt/VAR Control
- Power Quality manager
- Seamless islanding transitions
- Smoothing/ramp-rate control



MICROGRID CONTROL HIERARCHY

SECONDARY

Performed by Mircorgrid controller

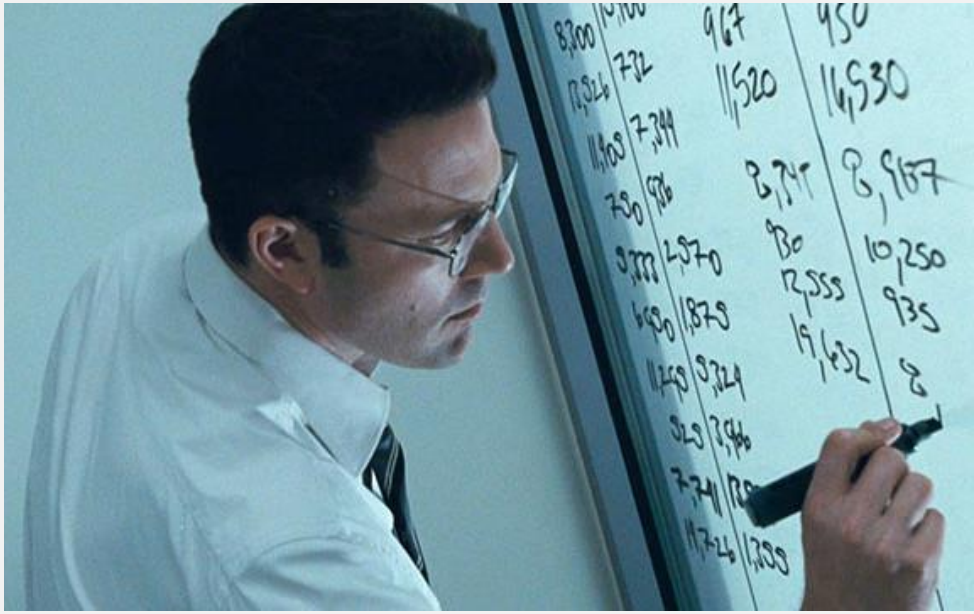
- Generation dispatch
- Load control
- Renewables monitoring and control
- Coordinates islanding transfers
- Integration with utility ADMS System
- Storm preparedness

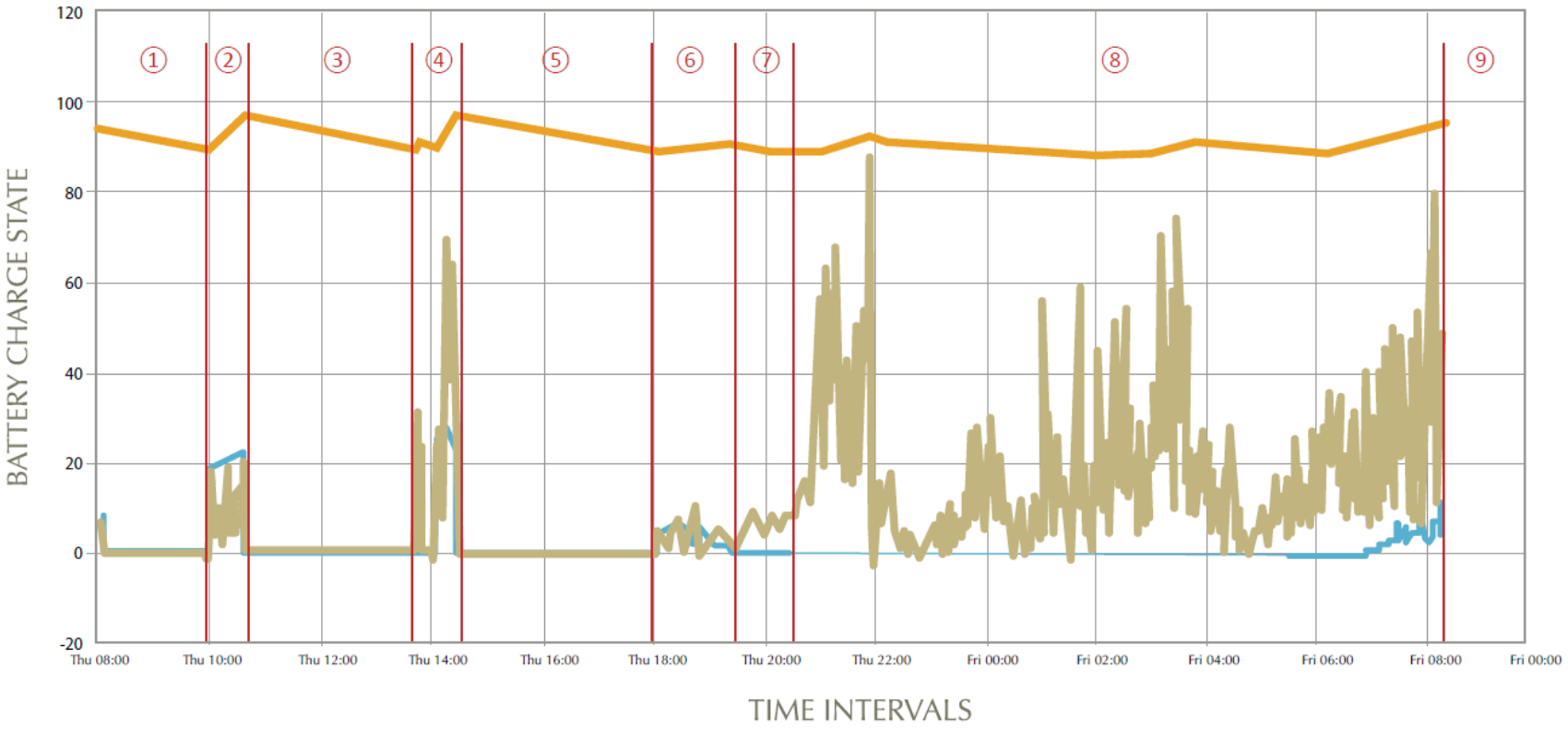
MICROGRID CONTROL HIERARCHY

TERTIARY

Performed by financially focused controller

- Load forecasting
- Generation & Weather forecasting
- Revenue stream prioritisation
- Market participation





24-Hour PureWave® SMS-250 Storage Management System Island Test at Ameren microgrid.
Start of test 8/3/17 8:00AM CST, Completion of test 8/4/17 8:00AM CST

① Start of 24-hour SMS Island Test. State of Charge 97%, Solar & Wind off. SMS powers microgrid load.
② SMS State of Charge < 90%, system dispatches Solar & Wind. Solar & Wind power microgrid load and excess power charges SMS.
③ SMS fully charged to 97%, curtails Solar & Wind to zero output. SMS powers microgrid load.
④ Daytime cycle similar to interval #2. Higher wind output.
⑤ Daytime cycle similar to interval #3.
⑥ SMS SoC < 90%. Approaching Sunset, thus low solar output. Low wind output. Still enough Solar & Wind to power load and slowly charge SMS.
⑦ Dusk. Solar Inverter shuts off. System relies on wind power to deliver microgrid load and SMS to provide voltage reference.
⑧ System successful through night-time with strong winds and SMS. Microgrid load powered the entire time.
⑨ 24-hour SMS Island Test complete. SMS never dropped below 88% SoC. Sunrise brings solar power back up.

Battery
Solar
Wind

S&C ELECTRIC COMPANY
Excellence Through Innovation

QUESTIONS?

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