ENERGISE Program Kickoff

DOE Award #: DE-EE0008001

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Integration of a DER Management System in Riverside
University of California, Riverside

October 11, 2017

Project Team

Name	Role	Main Responsibilities
University of California, Riverside	PI	Project Management, Test Site, Algorithm Development
Riverside Public Utilities	Subcontractor	Test Site
Smarter Grid Solutions	Subcontractor	Framework Development, Field Implementation, Test Planning
Lawrence Berkeley National Lab	Subcontractor	Algorithm Development, Test Planning
Pacific Gas & Electric	Subcontractor	Hardware-in-the-Loop Testing, Scaled-up Simulation
Lawrence Livermore National Lab	Subcontractor	Algorithm Development
Grid Bright	Subcontractor	Data Management, Software Interoperability, Cyber Security

Project Goals

❖ Develop and validate a DER management system (DERMS).

❖ Contribute to and benefit from:

- Topology and Phase Identification
- Voltage/VAR Control Management
- Load and Power Flow Balancing
- Distribution System State Estimation

❖ **Energise Area 1 Project**: Near Term with Field Demonstration

Major Innovations

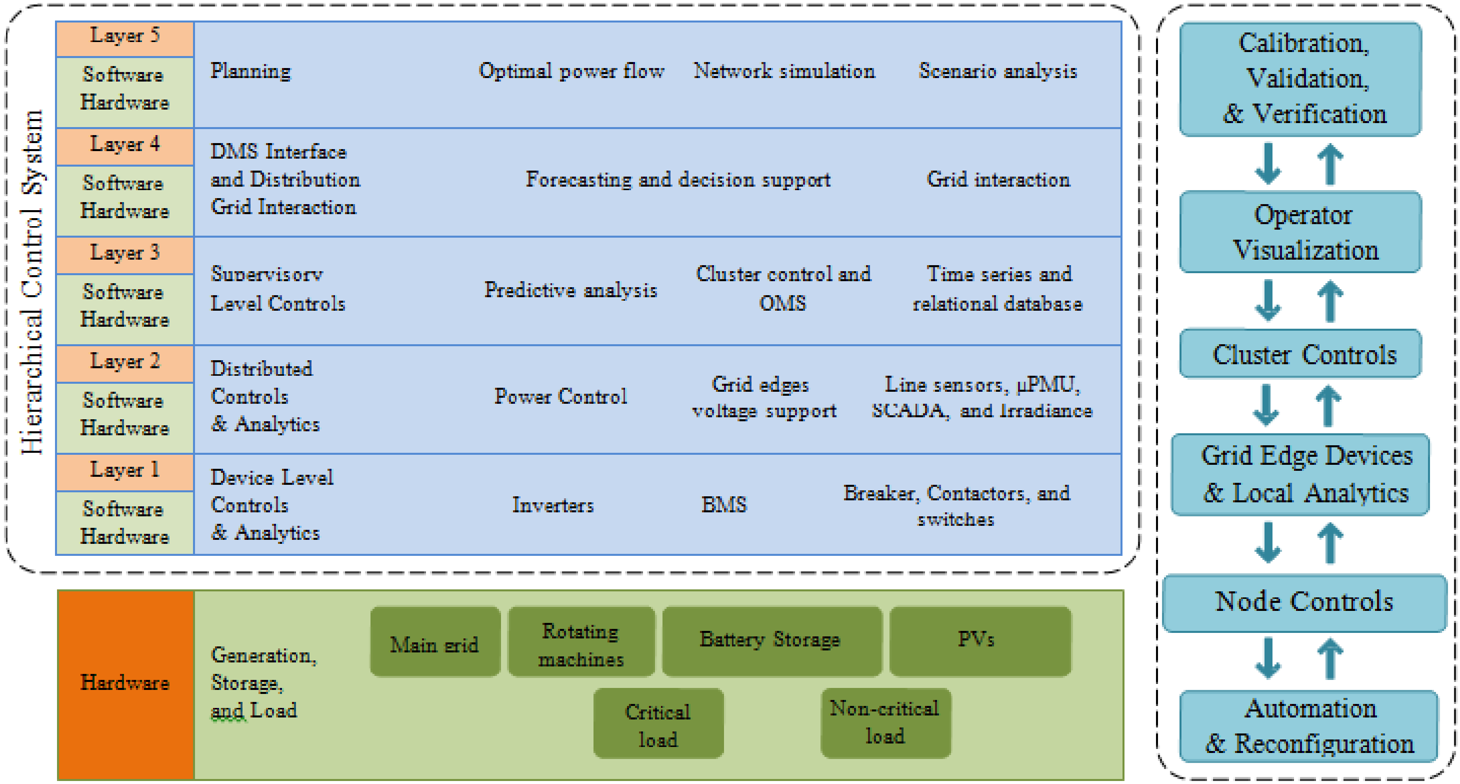
- ❖ The monitoring and control platform is multi-objective and hierarchical (Next Slide: Active Network Management).

- ❖ Distribution nodes are enabled to act as load and/or voltage control buses to contribute to project goals (Previous Slide).

- ❖ The algorithms will utilize distribution-level synchrophasor data (µPMUs), advanced line sensors, and other available sensors to infer network conditions that otherwise would have to be directly measured or computed from a model.

Major Innovations

- Active Network Management (ANM) Platform:



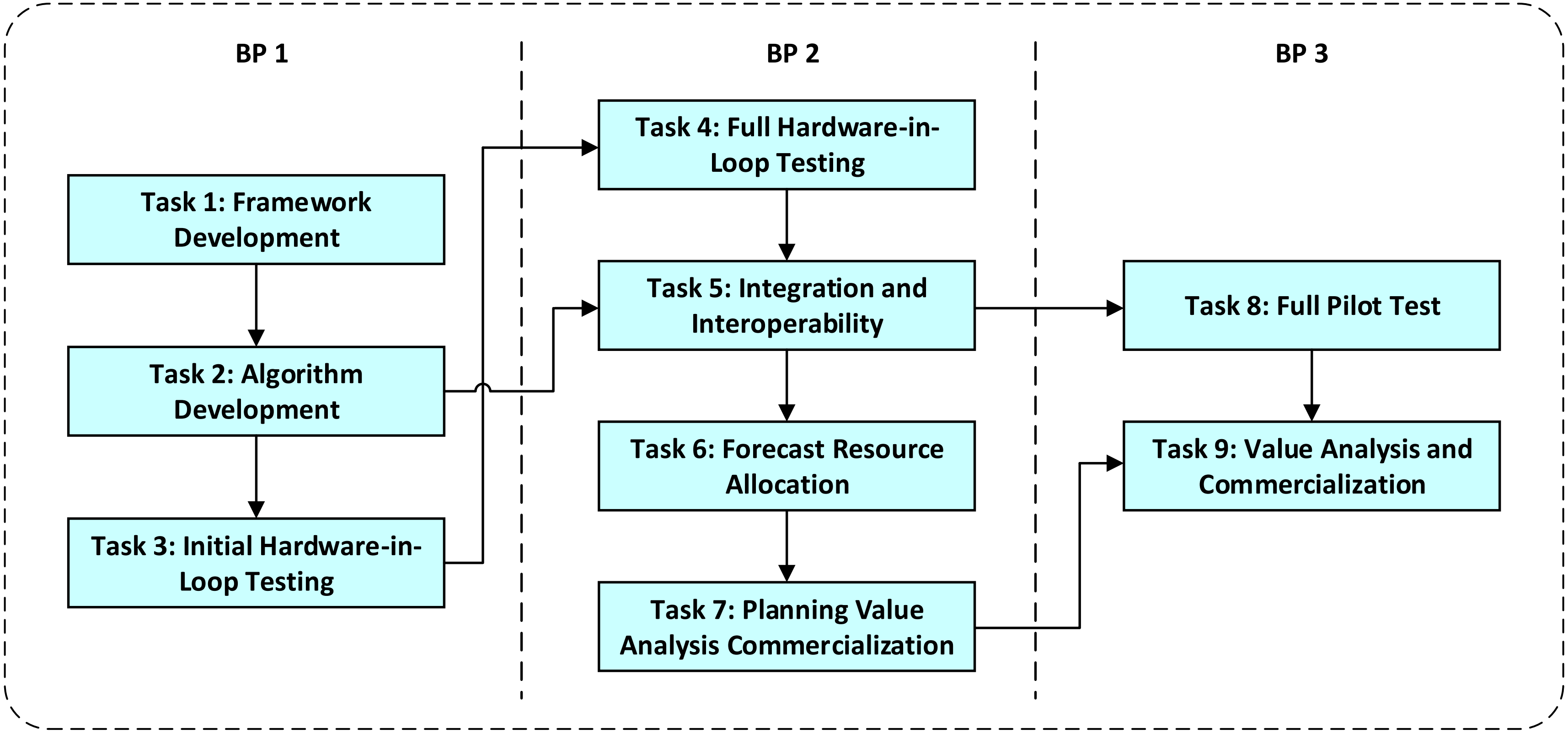
Hierarchical Control System

Layer 5 Software Hardware	Planning	Optimal power flow	Network simulation	Scenario analysis
Layer 4 Software Hardware	DMS Interface and Distribution Grid Interaction	Forecasting and decision support		Grid interaction
Layer 3 Software Hardware	Supervisory Level Controls	Predictive analysis	Cluster control and OMS	Time series and relational database
Layer 2 Software Hardware	Distributed Controls & Analytics	Power Control	Grid edges voltage support	Line sensors, µPMU, SCADA, and Irradiance
Layer 1 Software Hardware	Device Level Controls & Analytics	Inverters	BMS	Breaker, Contactors, and switches
Hardware	Generation, Storage, and Load	Main grid Rotating machines Critical load	Battery Storage	PVs Non-critical load

Calibration, Validation, & Verification
Operator Visualization
Cluster Controls
Grid Edge Devices & Local Analytics
Node Controls
Automation & Reconfiguration

Main Project Tasks

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy


BP 1
BP 2
BP 3
Task 1: Framework Development
Task 2: Algorithm Development
Task 3: Initial Hardware-in-Loop Testing
Task 4: Full Hardware-in-Loop Testing
Task 5: Integration and Interoperability
Task 6: Forecast Resource Allocation
Task 7: Planning Value Analysis Commercialization
Task 8: Full Pilot Test
Task 9: Value Analysis and Commercialization

Project SubTasks – BP 1

❖ Task 1.0: Framework Development (M1 – M9)

- ST 1.1: High level Function Definition & Communication Architecture
- ST 1.2: Data, Software, Interoperability, Cybersecurity Plan
- ST 1.3: ANM Platform Requirements Specification
- ST 1.4: Design and Develop Network-Level Controller Framework
- ST 1.5: Design and Develop Hierarchical Controller Framework
- ST 1.6: Application Container Development
- ST 1.7: Cybersecurity Analysis of Sensing, Control, Communications

Project SubTasks – BP 1

❖ **Task 2.0: Algorithm Development (M1 to M12)**

- ST 2.1: Scenario and Objective Function Definition
- ST 2.2: Algorithm Development for Grid Reconfiguration
- ST 2.3: Algorithm for Top-level Optimization

Project SubTasks – BP 1

❖ Task 3.0: HIL Testing Setup and Initial Testing (M3 – M12)

- ST 3.1: Simulation/Validation Plan Development
- ST 3.2: Model Data Integration
- ST 3.3: Integrate ANM platform with HIL test yard
- ST 3.4: Single substation HIL test

Project Milestones/Deliverables

❖ Individual algorithms will be **integrated** into ANM platform.

❖ The algorithms will be tested at different levels:

- IEEE Test Systems
- Hardware-in-Loop Simulations

BP 1

- Scaled-up Simulations

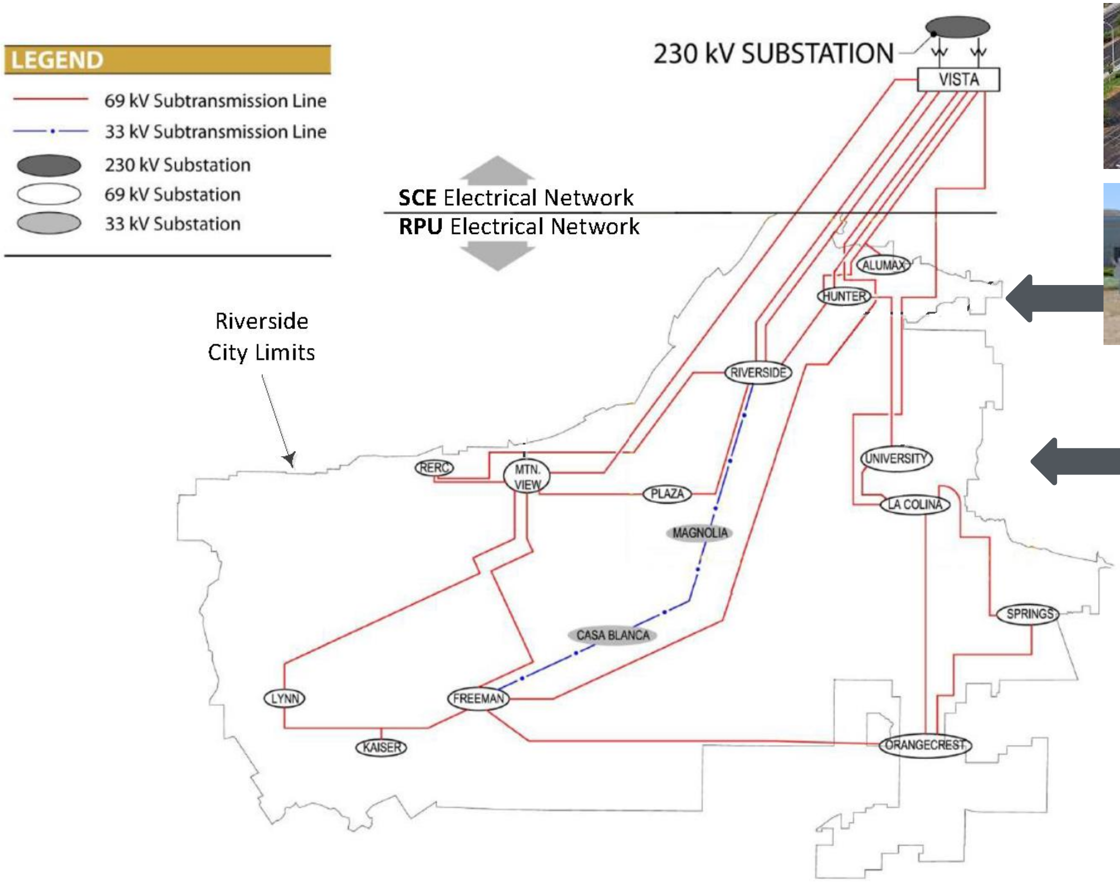
BP 2

- Real-World Field Implementation and Demonstration

BP 3

Project Milestones/Deliverables

- ❖ Potential Field Demonstration Sites:



UCR Off-Campus Labs

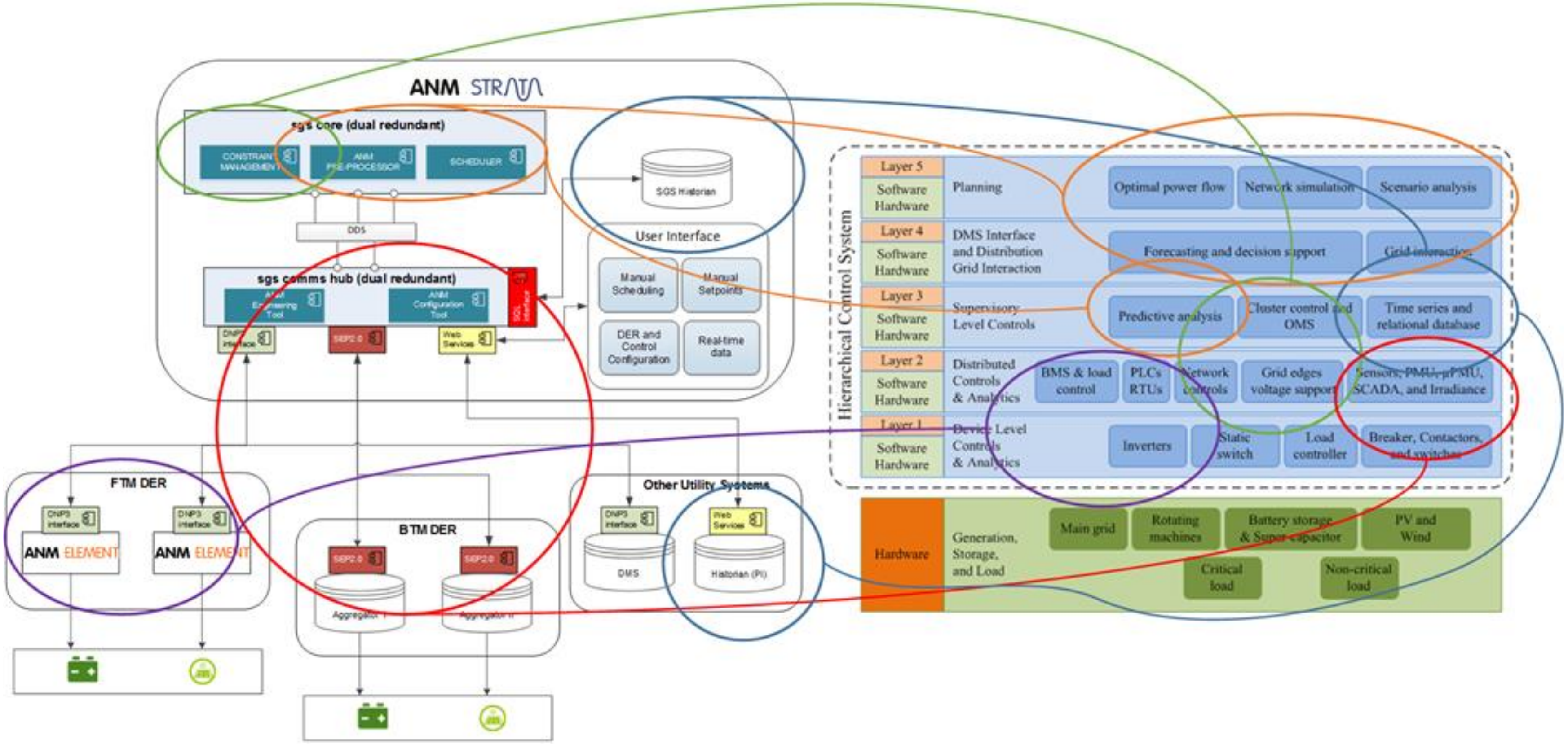
UCR Main Campus

Project Milestones/Deliverables

❖ BP 1 Deliverables:

- Framework Function and Communication Definition Specification
- Framework Design and Implementation Requirement Specification
- Overall Project Cyber Security and Interoperability Plan
- Algorithm Development and Performance Assessment Report
- HIL Site Acceptance Specification and Test Plan

Project Architecture



High Risks & Mitigation

❖ SubTask 1.7 (**Quarter 3**) will assess key risk areas:

- Such as loss of control, data confidentiality, security, etc.
- Cybersecurity and interoperability requirements will be updated
- Application container platform will be updated.

Milestone 1.7.1: Risk Assess & Risk Mitigation

Cybersecurity & Interoperability

- Make inventory of all components in solution design.
- Identify interfaces and integrations of new components.
- Identify technical protocols and data exchange mechanisms.
- Identify best practice, standard approach, or alternative approach.
- Create a threat matrix for each component and interface.
- Outline security, monitoring, and recovery plan.