2012 Smart Grid R&D Program
Peer Review Meeting

DE-OE0000549: Enhanced Distribution Management System Capabilities Supporting Distribution Network Distributed Energy Resources

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The Boeing Company
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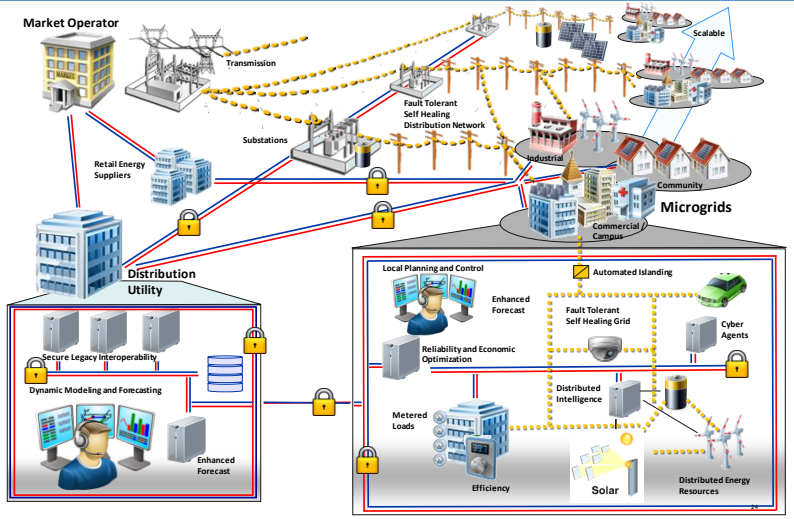
DE-OE0000549

Enhanced Distribution Management System Capabilities Supporting Distribution Network Distributed Energy Resources

Objective

1. Determine thresholds of Distributed Energy Resource (DER) penetration in distribution grids that drive significant impacts to network stability and reliability
2. Validate ability of Boeing Distribution Management System (BDMS) advanced controls to mitigate effects of increased DER and to leverage DER and DR for SAIDI and Load Factor improvement
3. Demonstrate interoperability and secure communication between utility management systems, associated databases, and distribution engineering modeling and analysis tools
4. Advance the capability of distribution engineering modeling tools to model smart grid operations



Life-cycle Funding Summary ($K)

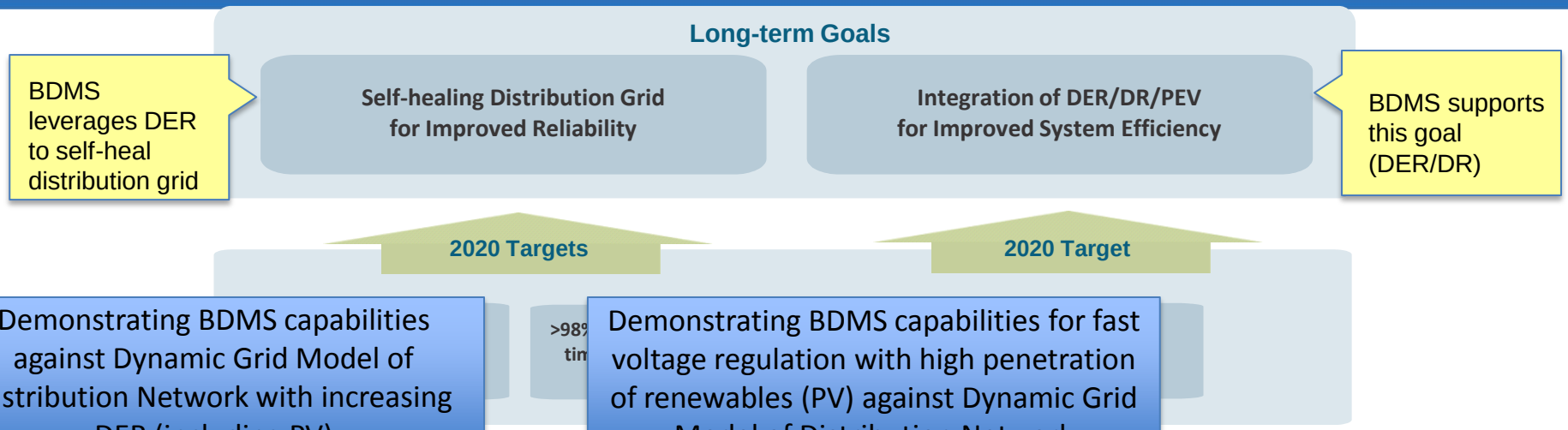
Prior to FY 12	FY12, authorized	FY13, requested	Out-year(s)
297.8	2,596.7	2,118.8	564.0

Technical Scope

- **System Definition–** Define Modeling and Simulation architecture and scenarios, use cases, product architecture and requirements; integrate and test system functionality against initial Dynamic Grid Model (DGM) of ComEd footprint
- **System Design –** Refine system use case definition; test BDMS against refined DGM in software environment; simulate load factor and SAIDI impact to distribution grid with increasing DER penetration; validate BDMS controls behavior in live hardware environment
- **System Demonstration –** demonstrate BDMS benefits against current-state and future-state distribution grid performance

Significance and Impact

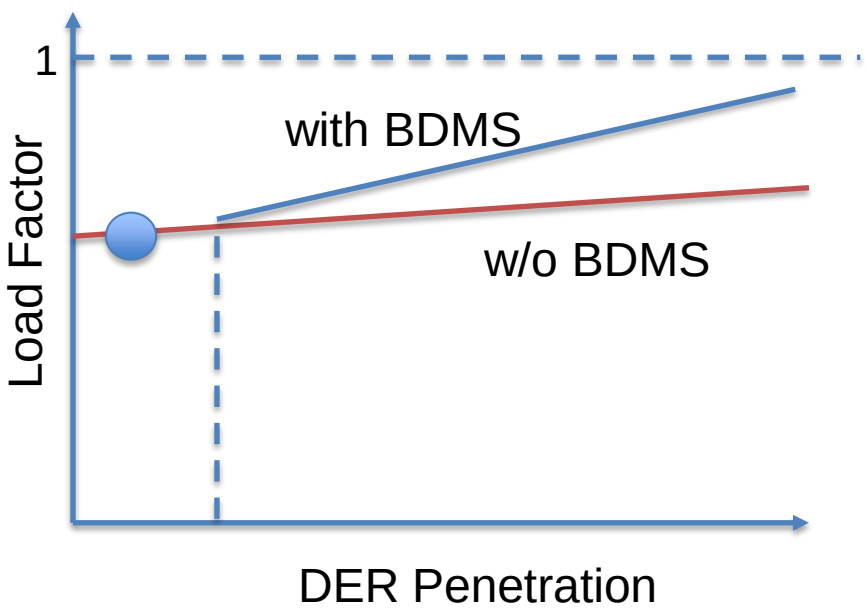
Smart Grid R&D Cost & Performance Targets

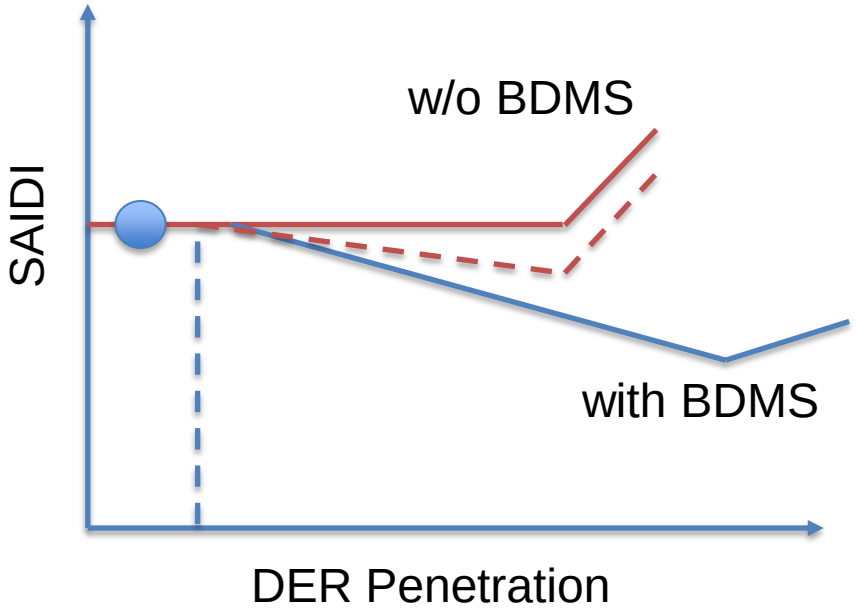


Annual Performance Targets				
2012	**2013**	**2014**	**2015**	**2016**
Demonstrate integration of renewable and distributed systems for 12% **load factor** improvement on a distribution feeder circuit	Demonstrate a smart **microgrid** at a military base for >98% reduction in outage time of critical loads	Enable fast voltage regulation technology to support integration of high penetration of distribution-level PV for 15% **load factor** improvement on the demonstration feeder circuit	Complete two integrated distribution management systems capable of reducing **SAIDI** by 5%	Demonstrate combined use of fault detection, isolation, and restoration technologies with integrated distribution management systems to reduce **SAIDI** by 10%

Smart Grid R&D Cost & Performance Targets

Notional graphs showing benefit of advanced controls as a function of DER penetration

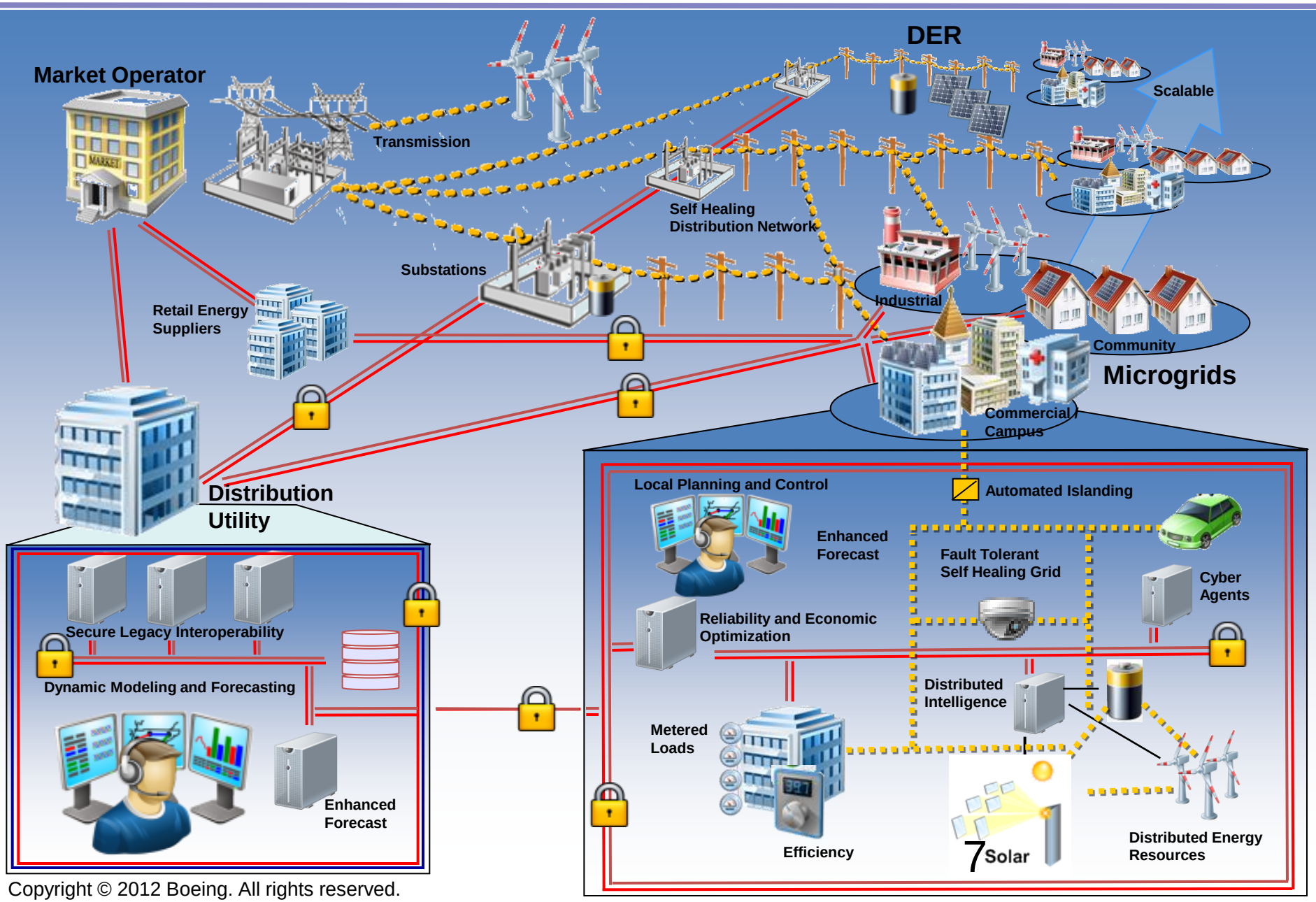




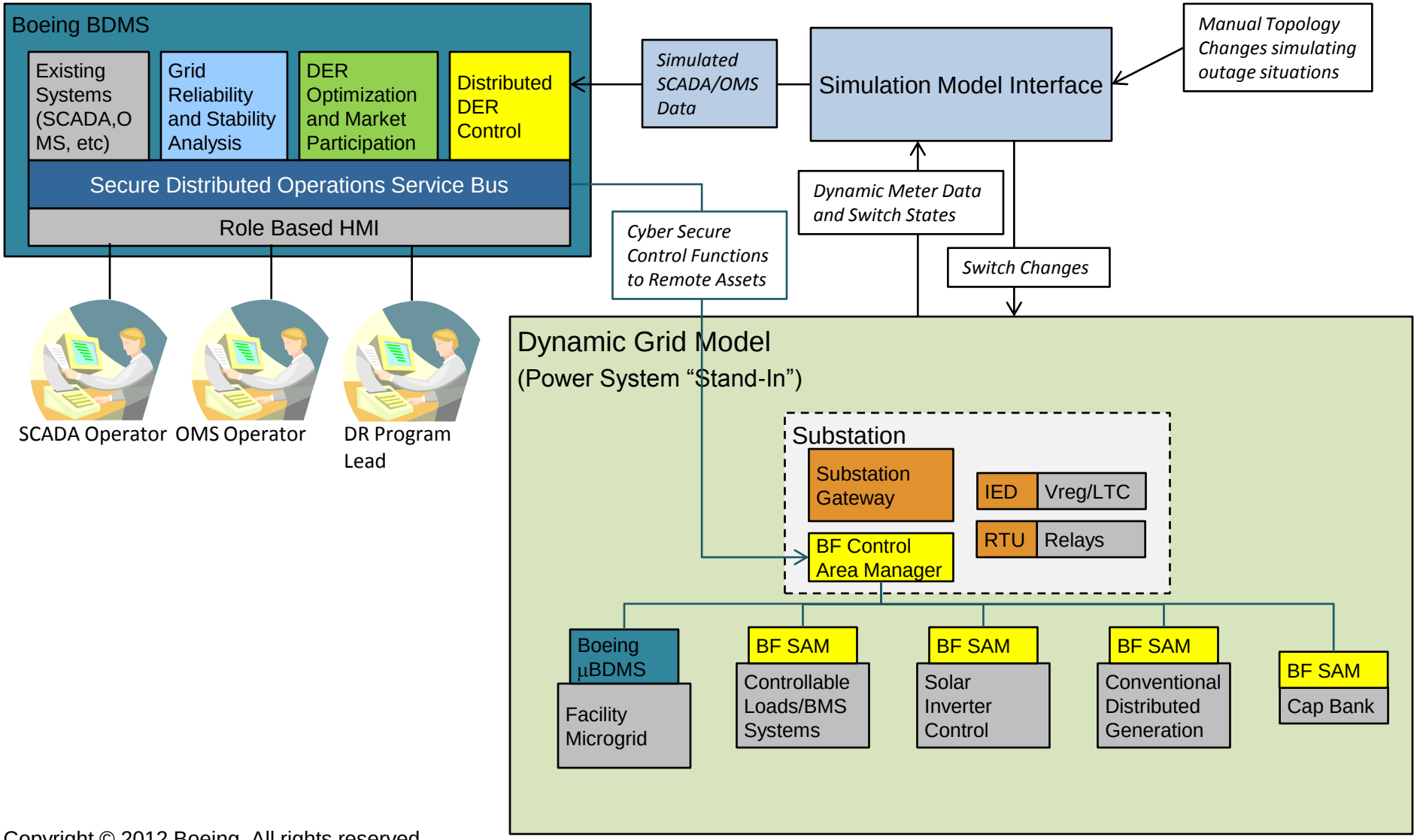
- Project will analyze load factor and SAIDI improvement as a function of DER penetration for a typical section of ComEd's distribution network
- DER penetration below threshold level has little to no affect (current state)
- BDMS real-time controls enable a higher load factor as DER is increased
- BDMS will leverage DER to power stranded network segments, reducing outage durations
- Facility based microgrids with local generation and control will have reduced outage duration, but may not be considered in SAIDI metric improvement (dashed red line)

Technical Approach & Transformational R&D

Conceptual Future View

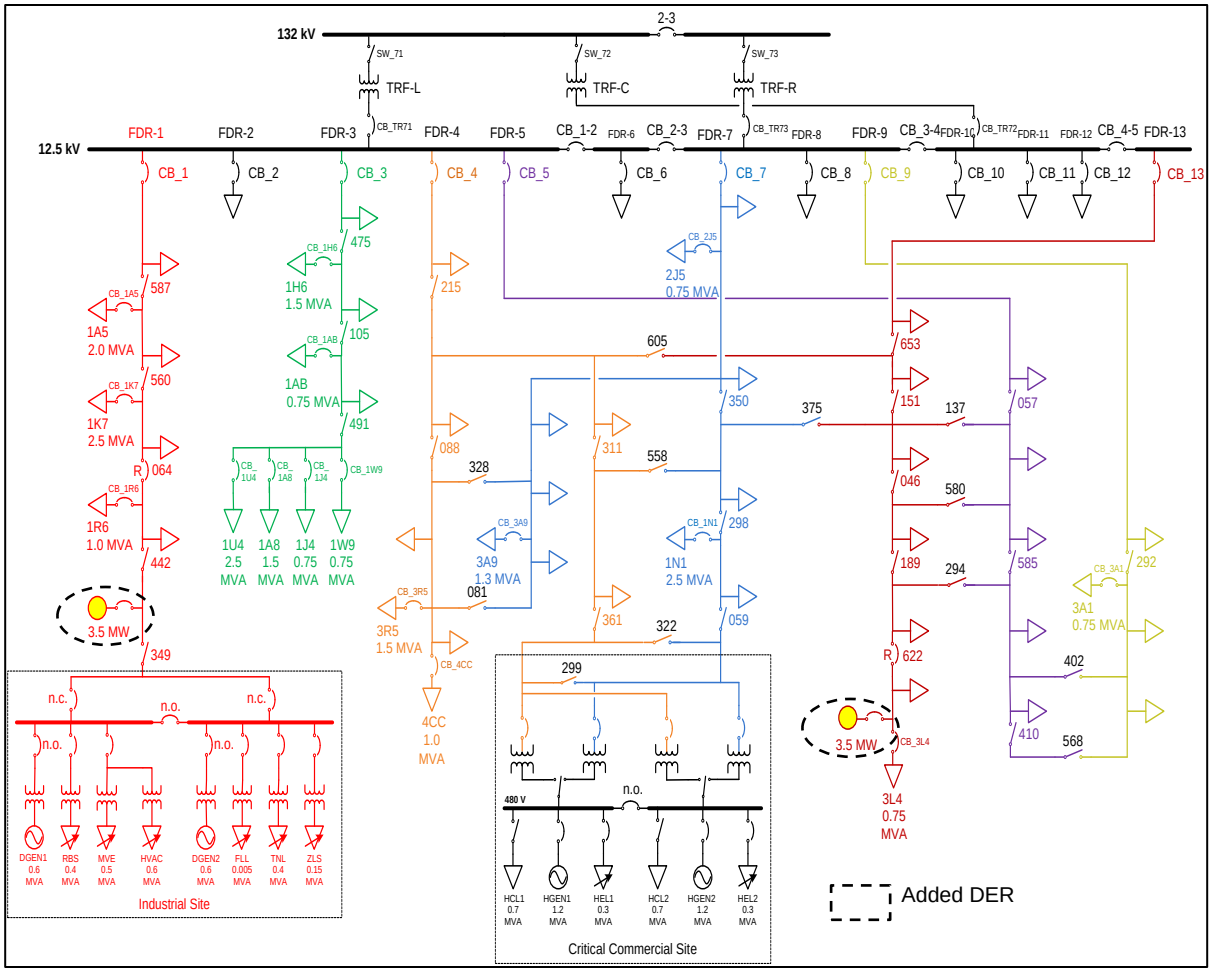


Technical Approach

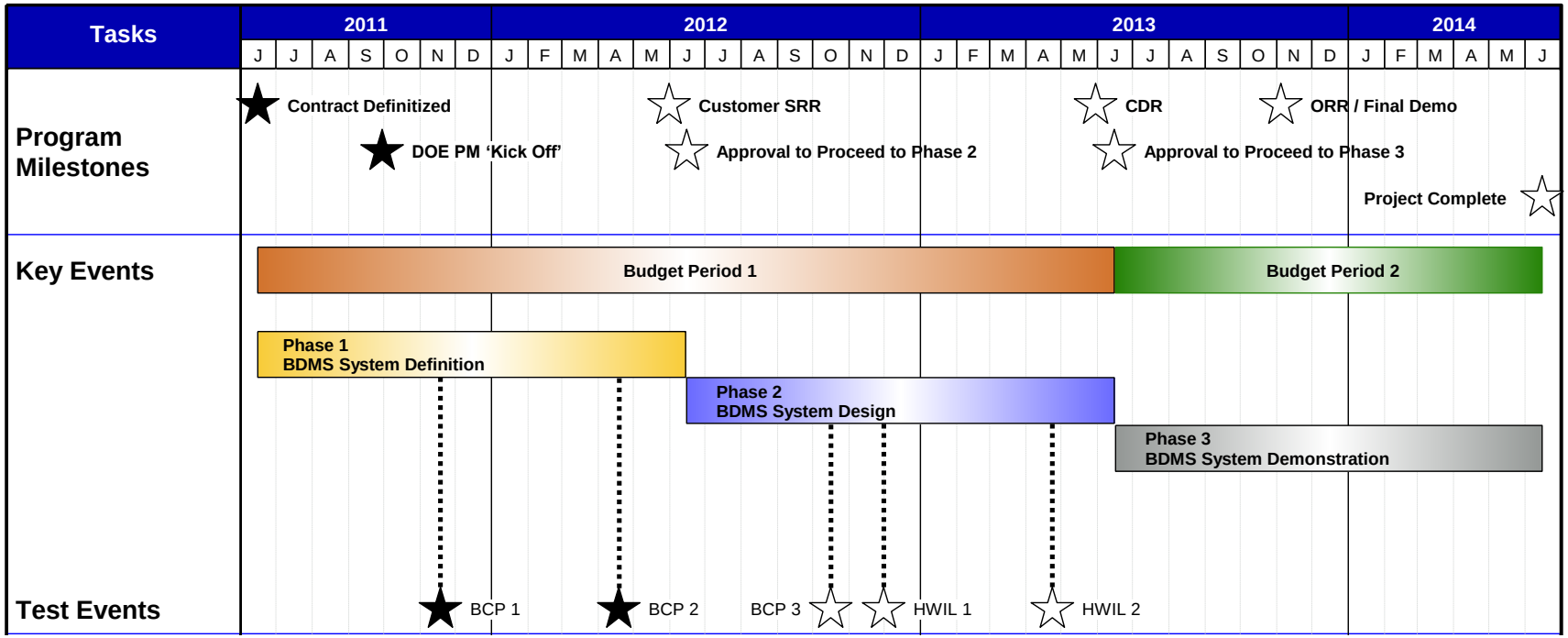


Target Area Dynamic Grid Model

- Dynamic model of section of ComEd distribution network
- Created from ComEd GIS extract
- 60MW Peak
- One substation with 15 Feeders (7 used for experiment)
- Enhanced with following scalable DER:
  - Solar characterized by local 10MW installation
  - Residential Solar
  - Industrial site Microgrid
  - Critical commercial site Microgrid



Technical Accomplishments



Accomplishments – FY 11

- Requirements, use cases, and system architecture definition
- Trades to select section of ComEd distribution grid for simulation and demonstration (Target Area)
- Collection of data required to create the simulation model
- Initial Dynamic Model of Target Area
- Defined approach for injecting and scaling DER and probable types of DER
- Refinement of the model to include additional DER and areas of emphasis supporting use cases
- Data collection for Comms infrastructure
- Cyber security vulnerability analysis
- BDMS configuration for Target Area and Test (BCP1)

Accomplishments – FY 12

- Requirements, use cases, and system architecture refinement
- ComEd Operations RAD/JAD sessions for Role Based HMI configuration
- Dynamic Model updated to support use cases and test scenarios
- Data requirements defined for demonstration phase, begin interface development
- Execution of use cases against dynamic model (software)
- Execution of use cases with hardware-in-the-loop (Integrid Lab)
- Comms simulation and cyber vulnerability testing

Accomplishments – FY 13+

- Data analysis from phase 2 testing
- Completion of phase 2 system configuration and testing
- Establish plan for phase 3, aligned with utility acceptance test methodology
- Integrate utility data feeds
- Demonstrate near-real-time system execution driven by utility data streams
- Data analysis and report development

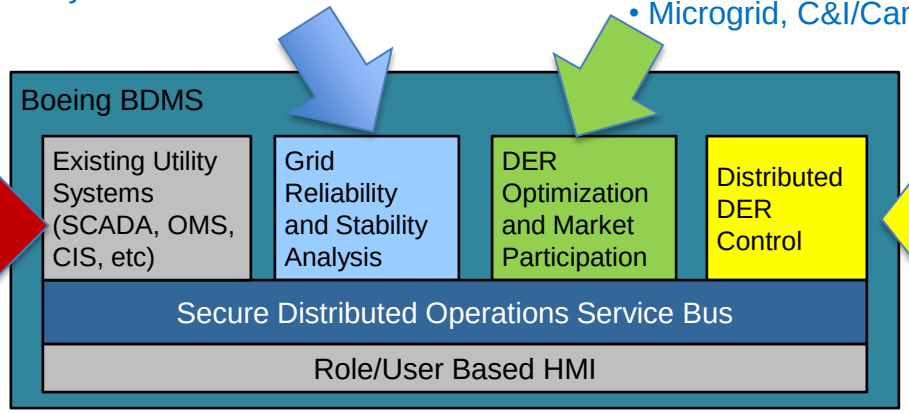
Project Team Capabilities

POWER ANALYTICS™
Foresight as accurate as hindsight™

- Change Planning / Impact Assessment
- Reliability/Health Assessment of Microgrid and Distribution Grid
- Power System Analytics & Validation

viridityenergy
power economics redefined

- DR/DER Optimization
- Interface with Market (PJM)
- Weather
- Availability, Price, & Schedule
- Microgrid, C&I/Campus,& Utility



ComEd
An Exelon Company

- Target area GIS/Asset Information
- Operator input to HMI configuration
- Existing system analysis
- Data feeds to support phase 3 demonstration
- Inputs and validation for use cases

Spirae
The Power Behind Renewable and Distributed Energy

- Distributed Energy Resource integration and control in Distribution Network and Microgrids
- Volt/Var and frequency control
- Distributed Controls Architecture for Robust Operation
- Dynamic Grid Model and Simulation of Target Area

BOEING

- Operations Svc Bus
- Cyber Security
- Grid Communications Model
- C2 HMI User Environment
- Service Level RBAC
- Quality of Service and Bandwidth Management
- Integration of Applications to Unified user interface

Contact Information

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