

JCTD SPIDERS Phase 2 Technical Overview

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SPIDERS Partners

- OSD
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- USACE/ERDC-CERL
- Military Services
- 5 DOE National Laboratories
- US Army TARDEC
- Naval Facilities Engineering Command
- Local Utility Companies
- States of Hawaii and Colorado



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The SPIDERS Multiphase Approach



STAIRWAY TO ENERGY SECURE INSTALLATIONS

Phase 1

PEARL-HICKAM CIRCUIT LVL DEMO

- Solar Renewables (8-9%)
- Two (2.4 MW) Generators
- Energy Management Sys
- Cyber architecture SCADA evaluation at Sandia National Labs

Phase 2

FT CARSON MICRO-GRID

- Large Scale Renewables
- Vehicle-to-Grid
- Smart Micro-Grid
- Critical Assets
- Cyber Security Test (Lab and Live Grid)

Phase 3

CAMP SMITH ENERGY ISLAND

- Entire Installation Smart Micro-Grid
- Grid-tied & Islanded Operations
- Distributed Renewables
- Demand-Side Management
- Redundant Backup Power
- Ancillary Services
- Makani Pahili Hurricane Exercise

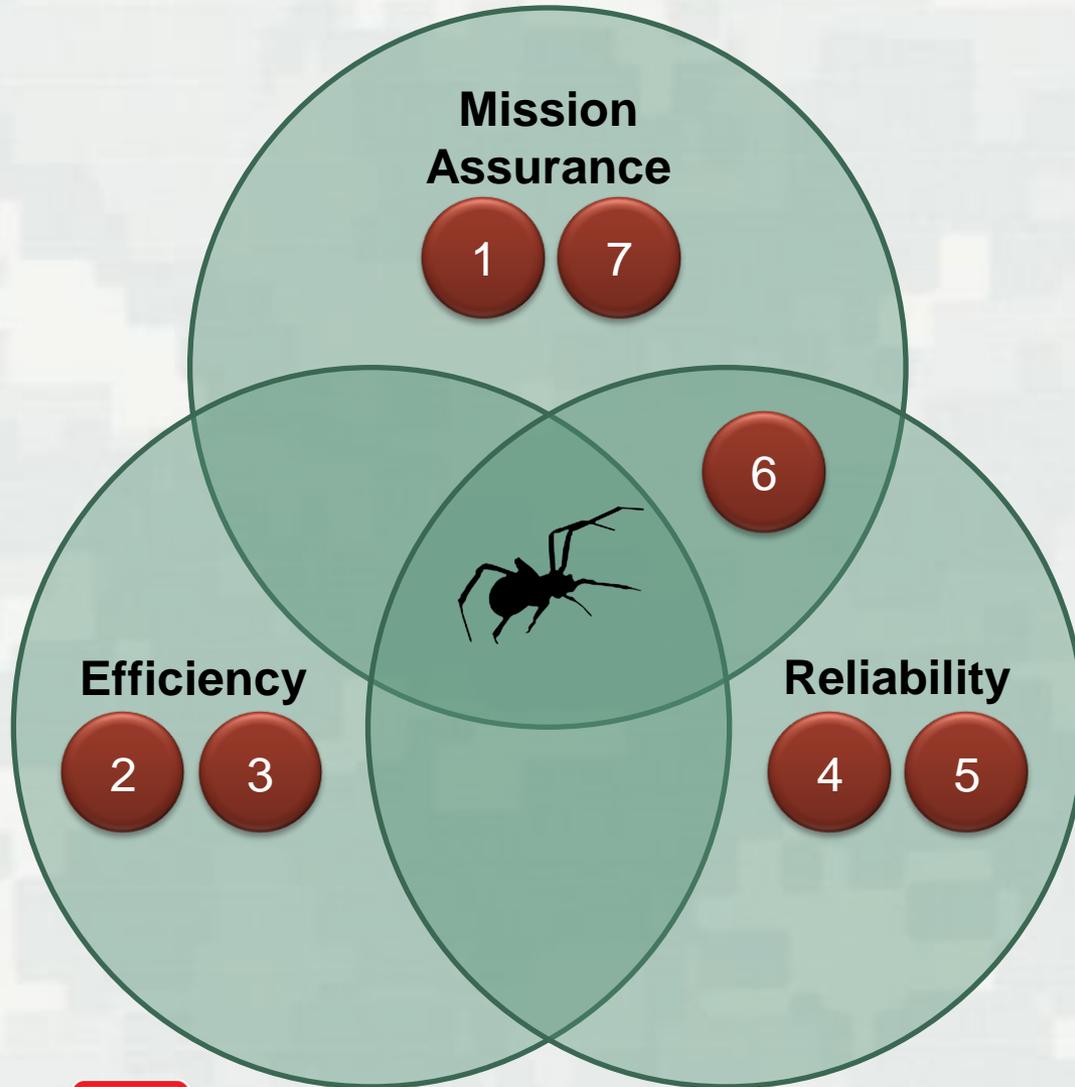
TRANSITION

- Template for DoD-wide implementation
- New Uniform Facility Codes
- CONOPS
- TTPs
- Training Plans
- DSIA Certification
- Transition to Electric Utility Sector
- Transition Cyber-Security
- Joint Base Architecture for Secure Industrial Control Systems (J-BASICS)

CYBER SECURITY BEST PRACTICES

RIGOROUS ASSESSMENT WITH RED TEAMING IN EACH PHASE

The SPIDERS Phase 2 and DOD Energy Security



SPIDERS Objectives and Capabilities

1. Improve reliability for mission-critical loads.
2. Reduce reliance on fuel by using renewable energy sources during grid outages.
3. Increase efficiency of generators through coordinated operation.
4. Reduce operational risk for energy systems through strong cyber security.
5. Enable full-load generator testing.
6. Provide N+1 backup power redundancy.
7. Allow critical mission buildings to receive backup power from multiple generators.



The SPIDERS Multiphase Approach



- Two generators (2.4 MVA)
- 150 kW solar array
- Single Distribution Feeder
- Accredited System Security
- Critical Facility Support

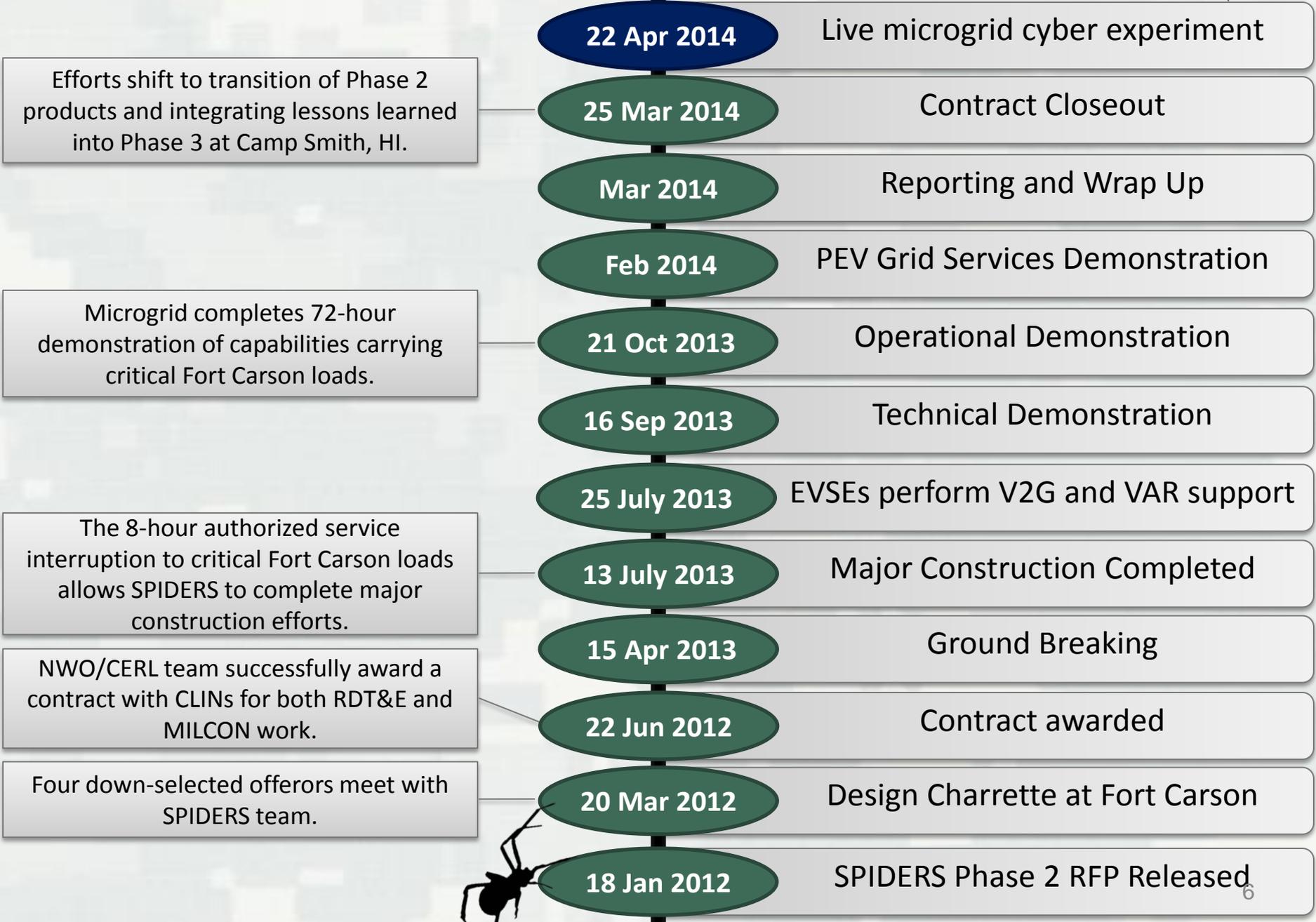


- Three generators (3.5 MVA)
- 1 MW solar array
- Three Distribution Feeders
- Functional Enclave Security
- 5 Bi-directionally Charging Electric Vehicles
- Critical Facility Support



- Seven generators (6 MVA)
- Three sub-microgrids
- Whole installation Support
- Strong Security Posture with external connections
- Tier 4i generators support daily peak-shaving operation
- Participating in utility programs to generate ROI
- Critical Facility Support

SPIDERS Phase 2 Timeline



The SPIDERS Microgrid at Fort Carson

- 1 MW solar connected, 500 kW functional for OD

- ▶ No modifications to PV inverters
- ▶ Proof-of-concept at JBPHH with 150kW PV array
- ▶ Maximum output prediction and metering manage PV integration.



- 5 Electric Vehicles with V2G Capability



- ▶ Provide some stabilization to microgrid
- ▶ Developmental converter/aggregator interfaces with microgrid control system
- ▶ Intended to provide demand response, peak shaving, and ancillary services in a wholesale market
- ▶ Active VAR injection from charging stations promises rapid payback.

Phase 2 Demonstrations

- Completed successfully with all microgrid resources online.
 - ▶ 1 MW of solar connected, 500 kW functional during Operational Demonstration
 - ▶ 4 electric vehicles connected: 1 Boulder EV, 3 Smith EVs
 - ▶ 5 EVSEs providing VAR injection (voltage support)
- Generator maintenance conducted during microgrid operation revealed important operational process lessons.
- SPIDERS Phase 2 follow up activities:
 - ▶ TARDEC led grid services demonstration with electric vehicles
 - ▶ Cyber security Red Team exercise.



SPIDERS Phase 2 Challenges

- Fires, Floods, and Furloughs
 - ▶ Waldo Canyon, Black Forrest
 - ▶ 9 September 2013 Flooding
 - ▶ Federal Furloughs and Shutdown
- Existing Infrastructure:
 - ▶ Designing around existing distribution
 - ▶ “Cherry picking” loads
 - ▶ Minimum impact mentality
 - ▶ Practical research projects
- Control System Maintenance and Sustainment
 - ▶ No ICS system owner (Army)
 - ▶ Long term security relies on good maintenance
 - ▶ SPIDERS IATT expires in 6 months.
- Integrating 3rd Party-Owned Assets
 - ▶ Consideration in design phase (segments, fiber)
 - ▶ Provisions in PPA for microgrid integration
 - ▶ SPIDERS integration could have higher utilization



Balancing Capabilities and Risk

- Introducing new vulnerabilities could eliminate the benefits of the microgrid.
- Strong security posture is required to realize the benefits of microgrid technology.
 - ▶ Must be maintained to remain strong.
- SPIDERS offers a demonstrated solution, but clear policy is needed for wider implementation.

Microgrid

Network Vulnerabilities
Advanced Control System
Renewables Integration
Improved Efficiency/Emissions
Higher Availability/Reliability

Traditional Backup

No Network
Limited Control
Aging Delivery System
Poor Efficiency/Emissions
No Backup Redundancy



Thank you!

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