

SPIDERS

Energy Security JCTD Proposal



Dr. George Ka'iliiwai, SES
BG Barbaranette Bolden

Mr. Ross Roley
USPACOM

Mr. Bear McConnell, SES
Dr. Bill Waugaman

Mr. Bill Beary
USNORTHCOM

This brief is:

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Interagency Operational Problem



DoD Energy Challenge: The ability of today's warfighter to command, control, deploy, and sustain forces is adversely impacted by a fragile, aging, and fossil fuel dependent electricity grid, posing a significant threat to national security.

- Inability to protect task critical assets from loss of power due to cyber attack
- Inability to integrate renewable and other distributed generation electricity to power task critical assets in times of emergency
- Inability to sustain critical operations during prolonged power outages
- Inability to manage installation electrical power and consumption efficiently, to reduce petroleum demand, carbon “bootprint,” and cost

The modern military needs to evolve its power infrastructure. New threats demand new defenses





What Is SPIDERS?



Reduce the “unacceptably high risk”* of mission impact from an extended electric grid outage by developing the capability to maintain energy delivery for mission assurance

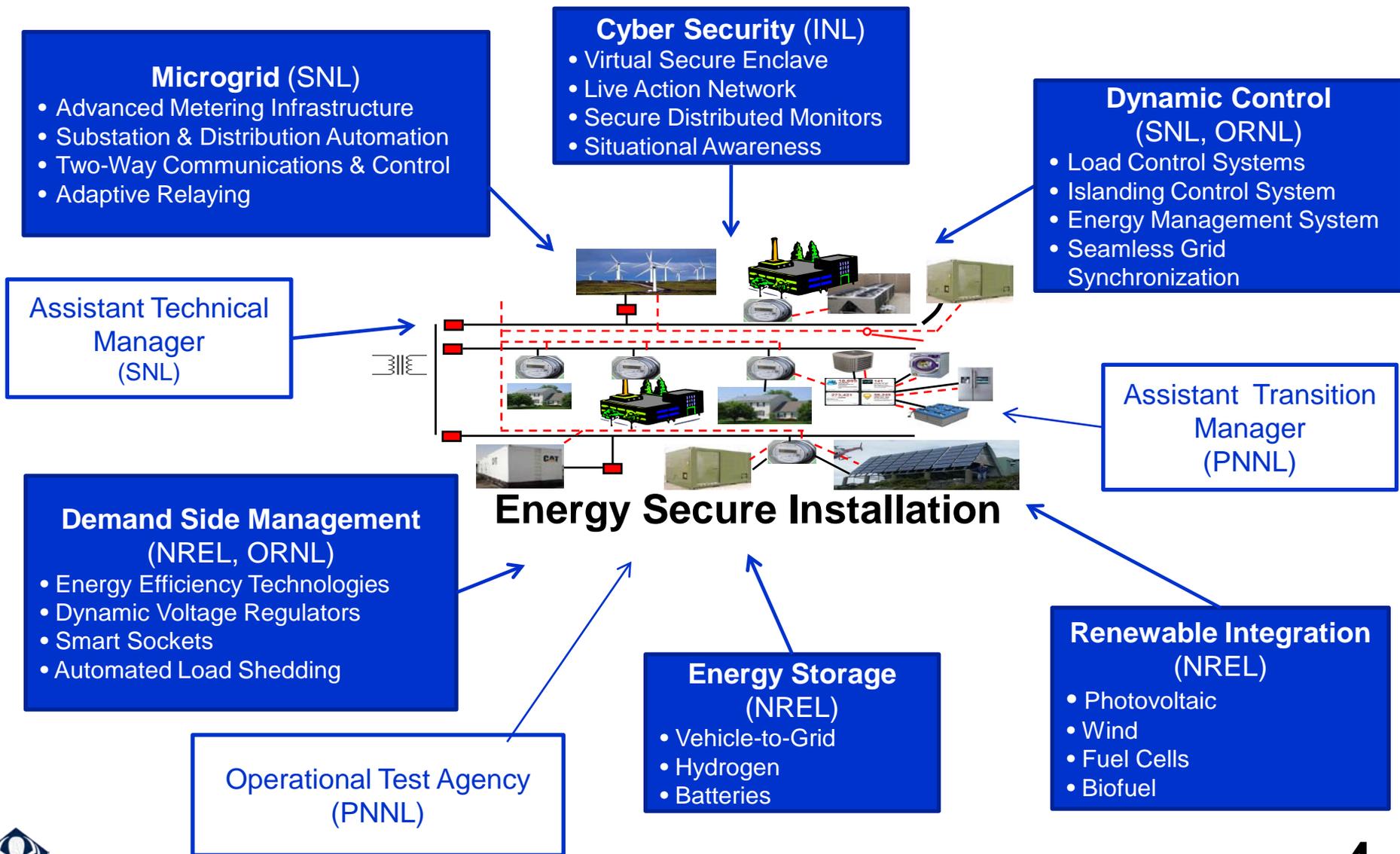
- ***Demonstrate:***
 - ***Cyber-security of electric grid***
 - ***Smart Grid technologies & applications***
 - ***Secure microgrid generation & distribution***
 - ***Integration of distributed & intermittent renewable sources***
 - ***Demand-side management***
 - ***Redundant back-up power systems***
- ***Results in:***
 - ***Technically sound, commercially viable secure microgrid demonstration with mixed generation including renewables***
 - ***First complete DoD installation with a secure, smart microgrid capable of islanding***
 - ***Template for mission critical asset energy security for an entire installation and transition to commercial use***

**From Defense Science Board Task Force on DoD Energy Security, Feb 2008*





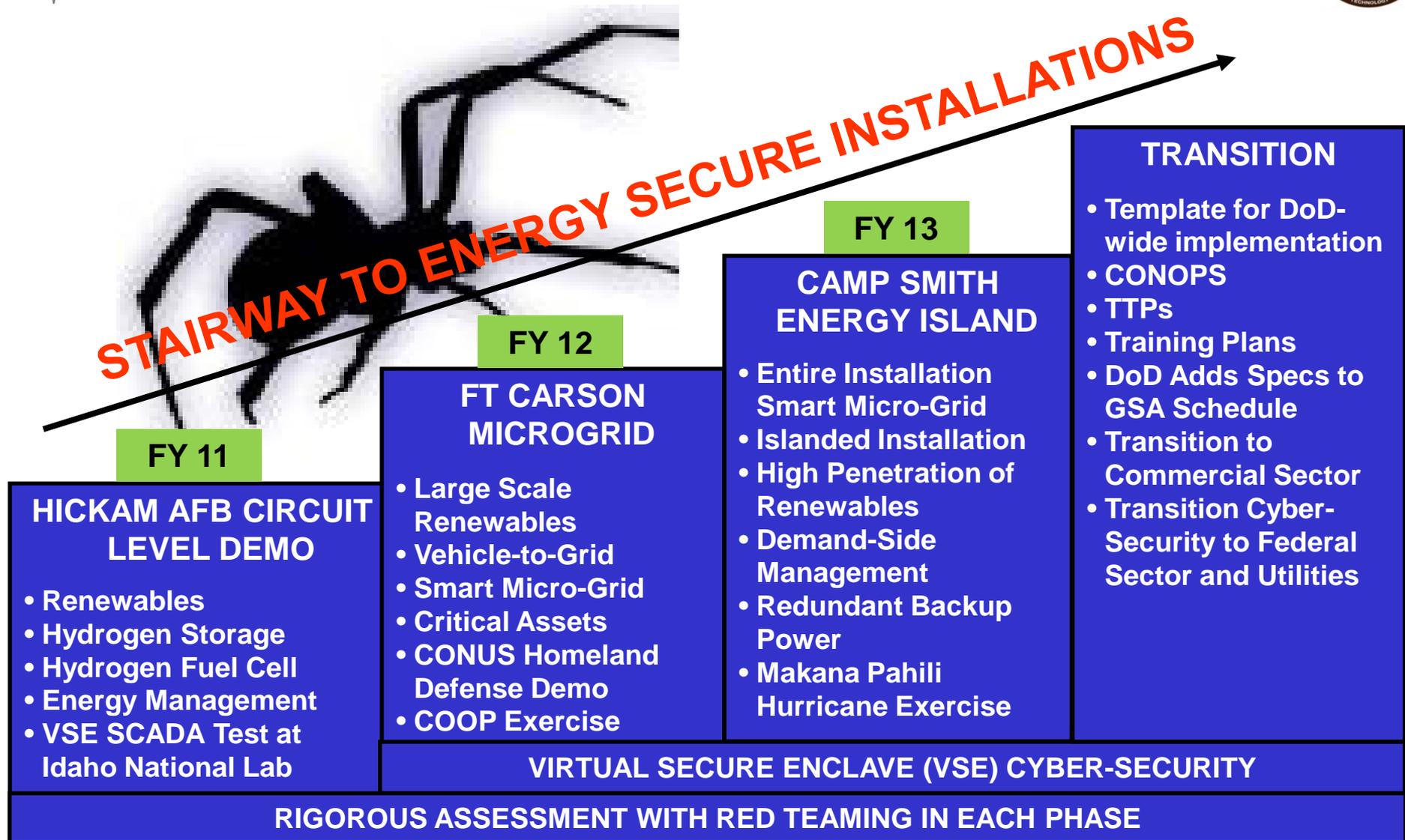
SPIDERS Secure Microgrid Technologies





SPIDERS Implementation Plan

STAIRWAY TO ENERGY SECURE INSTALLATIONS



SPIDERS Participants



- **USPACOM, USNORTHCOM
DOE, and DHS**
- **DOE - 5 Nat'l Labs**
- **DOEP&P Power Surety Task Force**
- **Military Services**
- **Naval Facilities Engineering Cmd**
- **Local Utility Companies**
- **States of Hawaii & Colorado**





SPIDERS Summary



- **Technical Idea:**

- Reduce the “unacceptably high risk” of extended electric grid outages by developing the capability to island installations while maintaining operational surety, security & cyber defense

- **Demonstration Approach:**

- Circuit level demo at Pearl/Hickam using renewables with hydrogen storage & fuel cells
- Ft Carson microgrid including renewables, vehicle-to-grid storage, energy mgt, cyber defense
- Camp Smith, HI complete installation smart grid, islanding, battery storage, cyber defense

- **Deliverables:**

- 12 months ARF – Cyber defense strategy tested at Idaho National Lab. Circuit level microgrid load balancing concept with hydrogen fuel cells proven at Pearl/Hickam, HI
- 24 months ARF – Continuity of Operations (COOP) exercise at Ft. Carson, CO proving cyber defense of smart microgrid protecting task critical assets

- **Transition:**

- Umbrella management led by Naval Facilities and Engineering Command

**SPIDERS Enhances National Energy Security
and Demonstrates Federal Government Leadership
In Transitioning America to a Secure Smart Grid**



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As of August 2010

SPIDERS – Smart Power Infrastructure Demonstration for Energy Reliability and Security



SMART POWER INFRASTRUCTURE DEMONSTRATION FOR ENERGY RELIABILITY AND SECURITY



Backup Slides





Joint Capability Technology Demonstration (JCTD)

Overview



- **The mission of a JCTD is to find, demonstrate, transition, and transfer the best operational concepts and technology solutions for transformational, joint, and coalition warfare.**
- **Accelerates cutting-edge technologies to the Warfighter by:**
 - **Speeding the discovery, development, and delivery of technology and concepts for sustained military capabilities with emphasis on capabilities that are innovative, transformational and joint;**
 - **Partnering with Services, Agencies, and Coalition elements to provide the best capabilities to Joint and Coalition warfighters;**
 - **Seeking the very best technical and operational concept solutions from Defense, industry and academic sources;**
 - **Leveraging "try before you buy" demonstrations, exploiting "test to procure" initiatives, and forging partnerships to create new technology and operational concept solutions for warfighters; and**
 - **Combining improved business processes to operationalize innovation faster than ever.**





The Situation



Defense Science
Board

Feb 08 - “Critical national security and homeland defense missions are at an unacceptably high risk of extended outage from failure of the electric grid.”



May 09 - “Aurora threat revealed the possibility that sophisticated hackers could seriously damage the grid by destroying mechanisms downstream from the initial point of attack.”



Feb 10 - “DoD will conduct a coordinated energy assessment, prioritize critical assets, and promote investments in energy efficiency to ensure that critical installations are adequately prepared for prolonged outages caused by natural disasters, accidents, or attacks.”

References:

- *The Defense Science Board Task Force on DoD Energy Security, “More Fight – Less Fuel,” February 2008.*
- *Powering America’s Defense, Energy and the Risks to National Security, by the Center for Naval Analyses Military Advisory Board, May 2009*
- *Quadrennial Defense Review Report, February 2010*

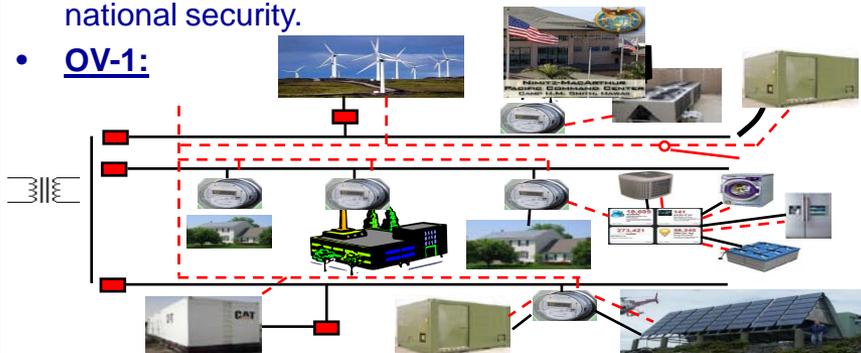


Quad Chart: SPIDERS JCTD FY11-13



- Operational Problem:** The ability of today's warfighter to command, control, deploy, and sustain forces is adversely impacted by a fragile, aging, and fossil fuel dependent electricity grid, posing a significant threat to national security.

OV-1:



Specifics:

- Circuit Level Micro-Grid Demo – Hickam AFB, HI**
 - Incorporate existing renewables, diesel generators and energy storage; add fuel cell and EMS; test micro-grid on an essential asset
- Validate VSE cyber security strategy on SCADA testbed simulation of utility grid mgt system – INL**

Year 2 & Beyond:

- Larger smart micro-grid with cyber defense and vehicle-to-grid storage leverages 2MW of existing PV and \$20M in recent electric upgrades – Ft. Carson, CO
- Entire installation cyber secure smart micro-grid with battery storage & islanding capability – Camp Smith, HI

Requirement:

- Protect task critical assets (TCAs) from loss of power due to cyber attack
- Integrate renewable and other distributed generation electricity to power TCAs in times of emergency
- Sustain operations during prolonged power outages
- Manage installation power/consumption efficiently

Competing Technology:

- Existing “dumb grid” with little or no cyber defense
- Renewables disabled/useless when grid goes down
- CANDID/POINT JCTDs address C2 nets, not SCADA

Funding (\$Thousands):

ORG	FY-11	FY-12	FY-13	TOTAL
DOE (tbd)	\$5,000	\$2,000	\$2,000	\$9,000
DHS (committed)	\$2,000	\$2,000	\$2,000	\$6,000
AF (committed)	\$1,000	\$500	\$500	\$2,000
Navy (committed)	\$1,000	\$500	\$500	\$2,000
Army (committed)	\$5,000	\$0	\$0	\$5,000
OSD I&E (committed)	\$6,000	\$3,000	\$3,000	\$12,000
OSD/RFD (committed)	\$4,000	\$1,500	\$1,500	\$7,000
TOTAL	\$24,000	\$9,500	\$9,500	\$43,000





What We Are Going To Do



Cyber-security – Demonstrate defense in-depth against cyber-attack through the application of Virtual Secure Enclaves strategy to smart electric grid control

Smart Grid technologies & applications - Incorporate technologies into the secure micro-grid to enable automated load balancing, two-way communication, smart-metering, and automatic system re-configuration

Secure generation & distribution micro-grid – Convert an entire installation to micro-grid and enable generation balancing and intentional islanding for extended continuity of operations

Integration of distributed & intermittent renewable sources – Ensure micro-grid stability through optimized use of renewables, energy storage, extend islanding operations, and reduce petroleum consumption and carbon footprint

Demand-side management – Reduce load footprint by optimizing efficiency, provide dynamic load shedding, and manage “after-event” load to maintain critical assets

Redundant back-up power systems – Ensure continuity of operations, provide an energy storage buffer for intermittent renewables, and enable seamless switchover from utility grid interconnection to intentional islanding

Culminates in an integrated demonstration of all of the above and a template for a DoD-wide approach to ensure installation energy security





SPIDERS – Step Wise Approach



Unique partnership opportunity for DOE to leverage DoD infrastructure for a step wise demonstration of secure microgrid technologies at scale

- Step wise approach reduces risk by allowing technologies to be tested on progressively larger scale prior to full deployment**
- Demonstrations on three installations enables testing of a broader and more complete suite of technologies (e.g. fuel cell, V2G, demand side management, VSE)**
- Demonstrations on three installations provides for more effective transfer to military & commercial use**





SPIDERS Secure Microgrid Technologies

Smart Grid

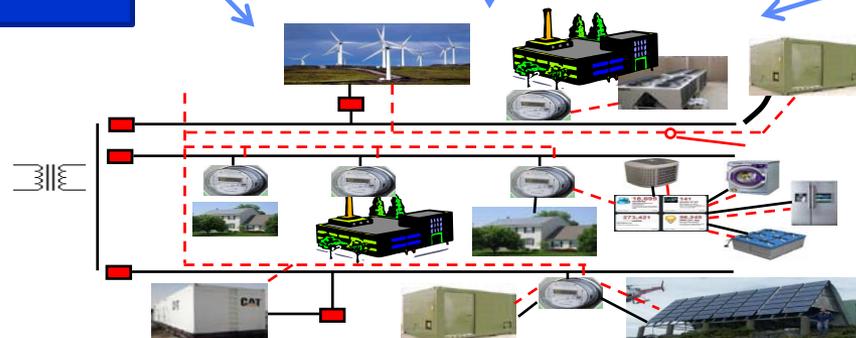
- Advanced Metering Infrastructure
- Substation & Distribution Automation
- Two-Way Communications & Control
- Adaptive Relaying

Cyber Security

- Virtual Secure Enclave
- Live Action Network
- Secure Distributed Monitors
- Situational Awareness

Dynamic Control

- Load Control Systems
- Islanding Control System
- Energy Management System
- Seamless Grid Synchronization



Energy Secure Installation

Demand Side Management

- Energy Efficiency Technologies
- Dynamic Voltage Regulators
- Smart Sockets
- Automated Load Shedding

Energy Storage

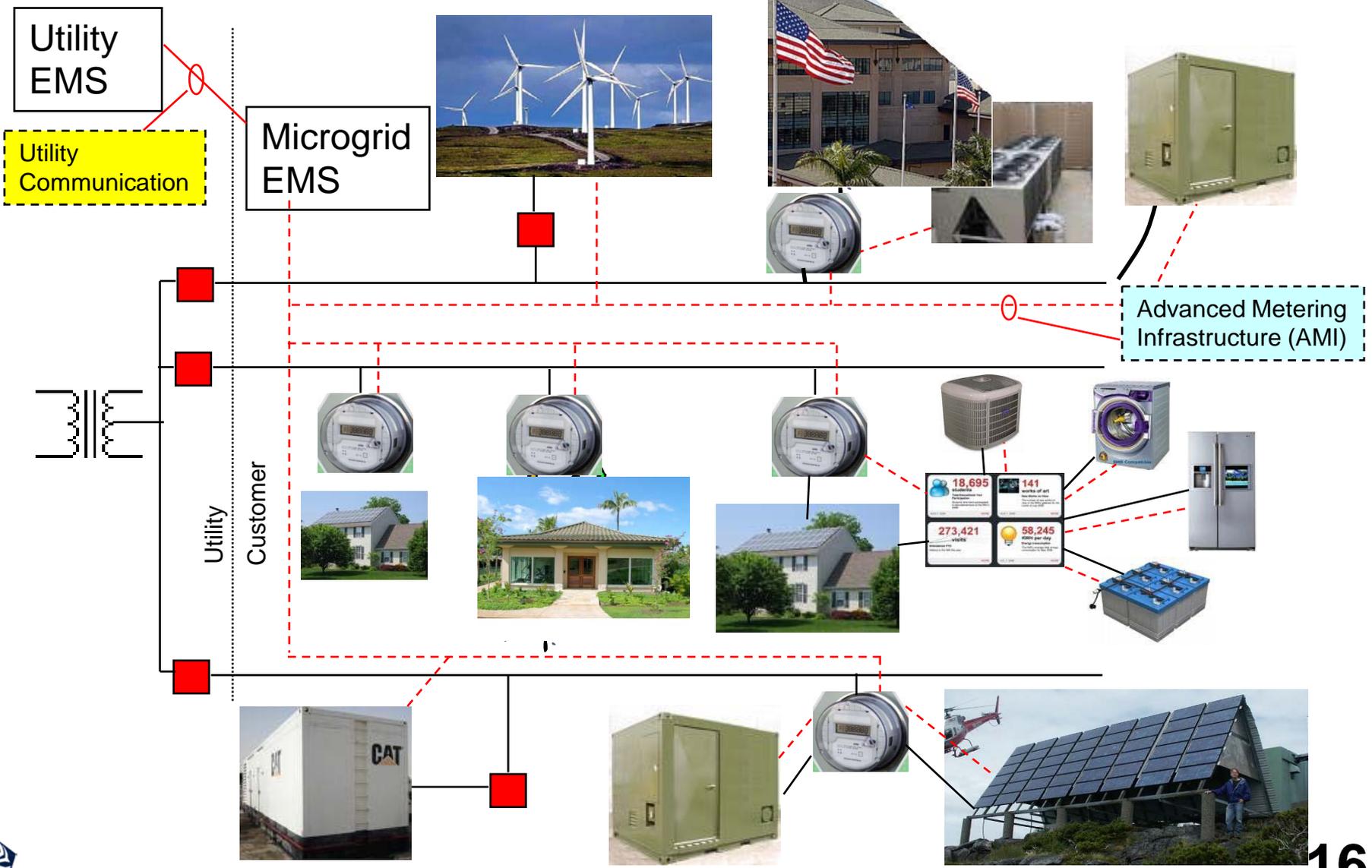
- Vehicle-to-Grid
- Hydrogen
- Batteries

Renewable Integration

- Photovoltaic
- Wind
- Fuel Cells
- Biofuel



SPIDERS Operational View





FY 11 Deliverables

- 1. Hickam AFB Circuit Level Microgrid Demonstration**
 - Incorporate existing renewables, diesel generators, and energy storage
 - Add fuel cell to backup local circuit
 - Test microgrid on an essential asset that has redundant power to simulate mission critical functions
- 2. Validate VSE Cyber Security Strategy on Test Bed Simulation of Utility Electric Grid Management System**
- 3. Initial Camp Smith Activities**
 - Install Advanced Metering Infrastructure (AMI)
 - Implement demand-side management
 - Offsite simulation of Camp Smith's secure, smart microgrid
- 4. Initial Ft Carson Activities**
 - Shared distributed grid tied backup generation
 - Begin electric vehicle to grid infrastructure upgrades
 - Begin incorporation of PV renewable generation





SPIDERS Organizational Chart

Oversight Group
 OSD/ATL(RFD), OSD I&E, OSD DOEP&P, USPACOM,
 USNORTHCOM, DOE, DHS, Navy/USMC, USAF, Army/TARDEC

Integrated Management Team
 User Sponsor: NAVY
 Operational Manager: USPACOM/USNORTHCOM
 Technical Manager: OSD PSTF
 Deputy Technical Manager: DOE(SNL)
 Transition Manager: NAVFAC/PNNL
 Oversight Executive: OSD/ATL(RFD)

Operational Manager
 USPACOM
 USNORTHCOM

Technical Manager
 Power Surety
 Task Force (PSTF)
 DOE/SNL

Transition Manager
 NAVFAC
 PNNL

