



**Smart Power Infrastructure Demonstration for
Energy Reliability and Security (SPIDERS)
Joint Capabilities Technology Demonstration (JCTD)**

FUPWG Brief

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N-NC Energy Security Lead



SPIDERS Participants



- **COCOM Sponsor:** PACOM and NORTHCOM
- **Oversight Executive:** Ms. Lenny Lopez and Lt Col Jane Gibson, OSD
- **Operational Manager:** Dr. Bill Waugaman and Mr. Bill Beary, NORTHCOM;
Mr. Ross Roley, PACOM
- **Technical Manager:** Mr. Harold Sanborn, U.S. Army Construction Engineering Research Laboratory (USACE/ERDC-CERL)
- **Transition Manager:** Mr. Bill Anderson, Naval Facilities Engineering Command (NAVFAC)
- **Other Participants/Partners:** Department of Energy (DOE) and Department of Homeland Security (DHS)



SPIDERS Overview

The ability of today's warfighter to command, control, deploy, and sustain forces is at risk because of a fragile, aging, and fossil fuel dependent electricity grid, posing a significant threat to mission assurance.

SPIDERS JCTD Objectives

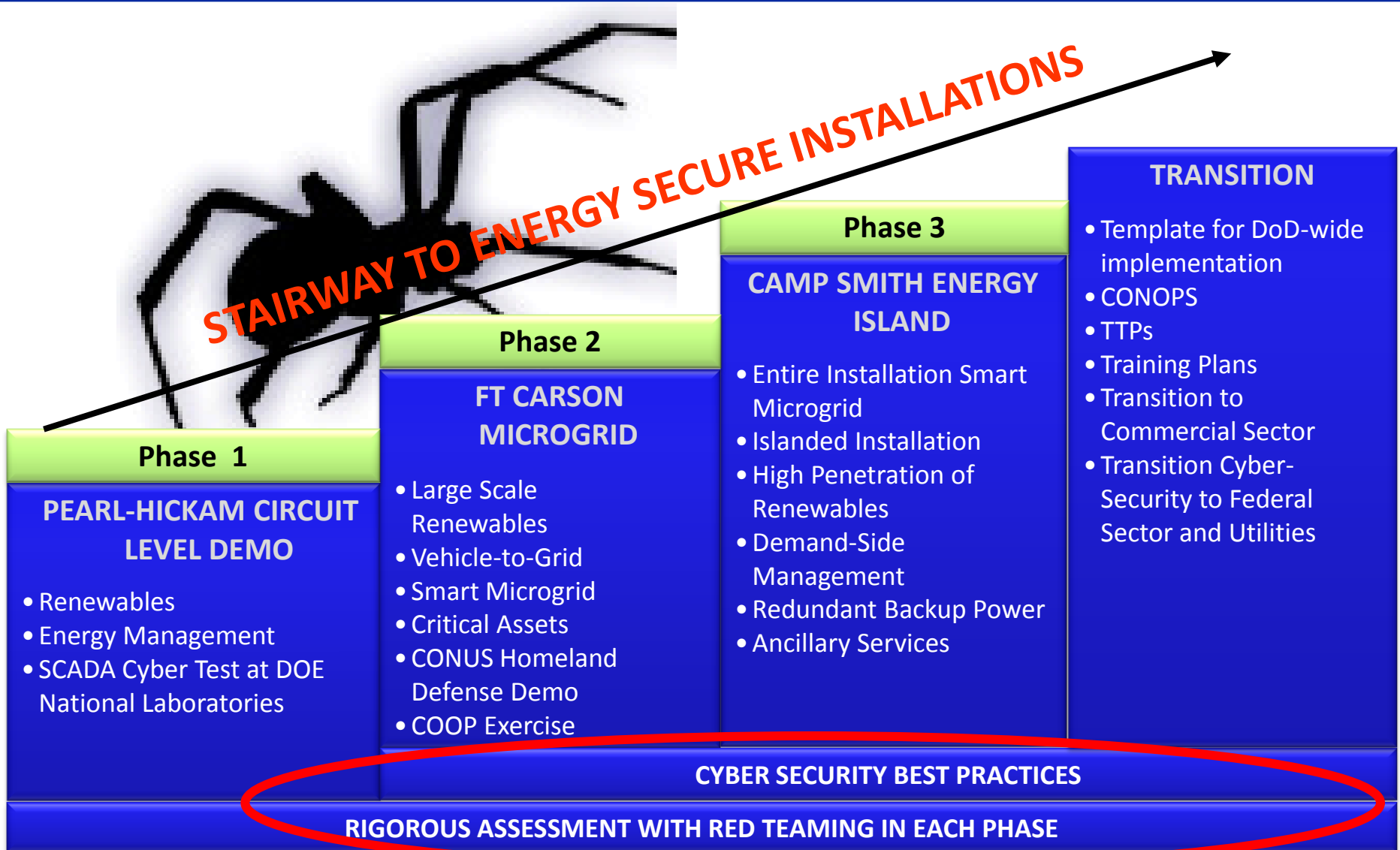
1. Protect task critical assets from loss of power due to cyber attack
2. Integrate renewables and other distributed energy generation concepts to power task critical assets in times of emergency
3. Sustain critical operations during prolonged power outages
4. Manage installation electrical power and consumption efficiency, to reduce petroleum demand, carbon "bootprint", and cost

SPIDERS primary objective is mission assurance



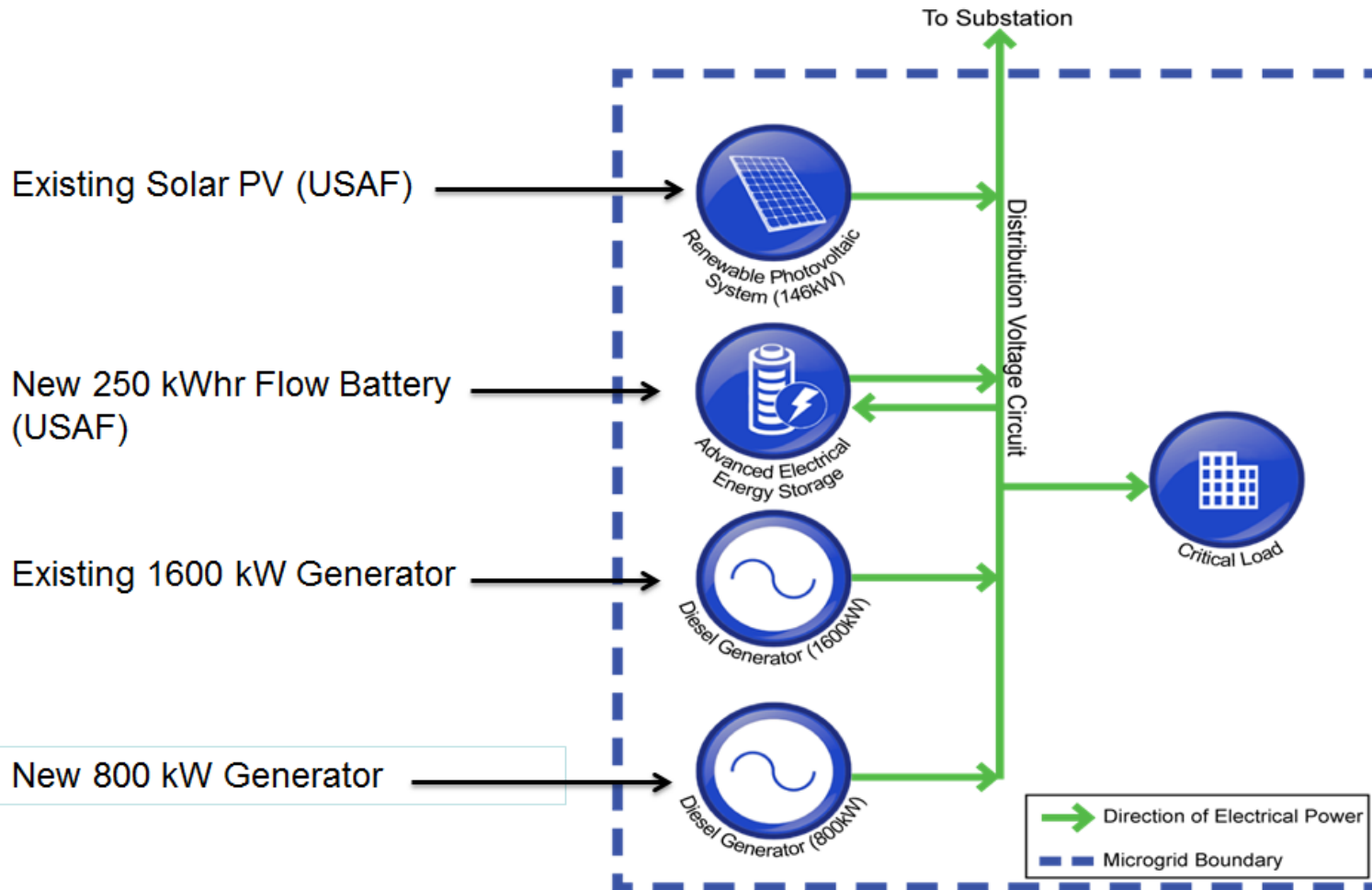
SPIDERS Program Summary

STAIRWAY TO ENERGY SECURE INSTALLATIONS





SPIDERS Phase 1 Microgrid Joint Base Pearl Hickam, Hawaii





SPIDERS Phase 1 Completed

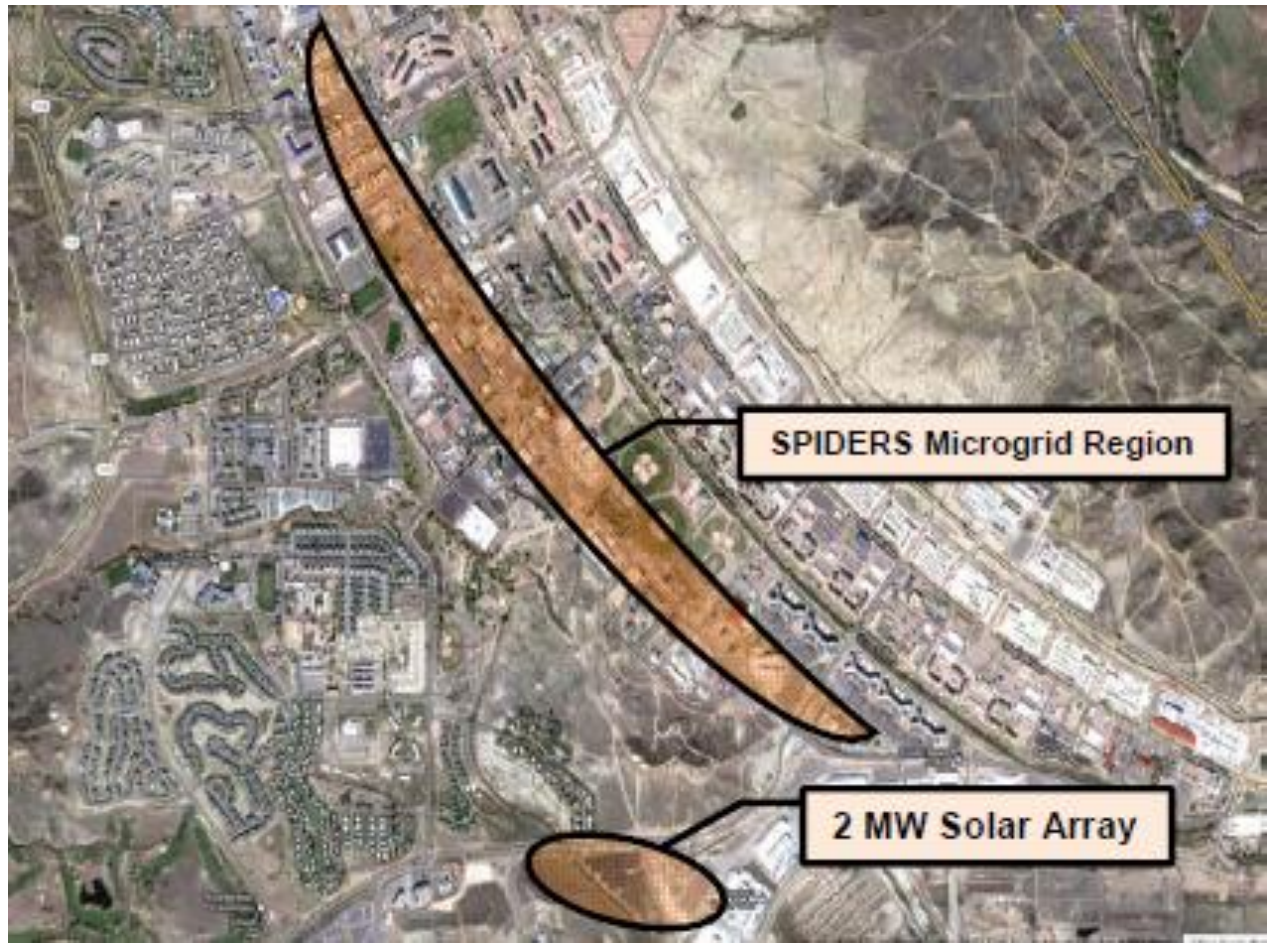


- **Successful Technical Demonstration (TD; 3-7 Dec 12)**
 - Seamless paralleling to the commercial grid when the microgrid reconnects to commercial power
 - Power export during loaded generator testing at over 1MW net export - effectively “slowing the meter” during monthly generator testing
 - Successful fully loaded black start operation without use of energy storage flow battery
- **Successful Operational Demonstration (OD; 22-25 Jan 13)**
 - Operational Test Agent - DOE Pacific Northwest National Laboratory (PNNL)
 - 72 hour test. No interruptions to critical load; renewables sources were integrated and reduced the amount of diesel fuel (reduced CO2 emissions by 42%); increased power endurance by 30.4%; improved power reliability by 39.2 fold; Cyber security was verified with a high level of compliance
- **Performed Successful Cyber Experiments/Assessments (Feb 13)**
 - Designed SPIDERS electric grid and control network architectures at the DOE Sandia National Laboratory. Tested architectures at the lab and on the live microgrid with red team attacks
- **Transitioned Microgrid Ownership and Artifacts to Navy Facilities Engineering Command, HI**
 - Signed Technology Transition Agreement (TTA), CONOPS, Draft Unified Facilities Criteria updates
- **Transition Manager Performed Site assessment at Camp Lemonnier (Africa)**
 - Used SPIDERS results/lessons learned, and performed an assessment for a potential microgrid install
- **Held First SPIDERS Industry Day (18 Jun 13)**
 - Shared results & lessons learned with public sector (policy & regulatory), utilities, energy companies

Phase 1 met all four SPIDERS JCTD Objectives



SPIDERS Phase 2 Microgrid Fort Carson, Colorado Army Base





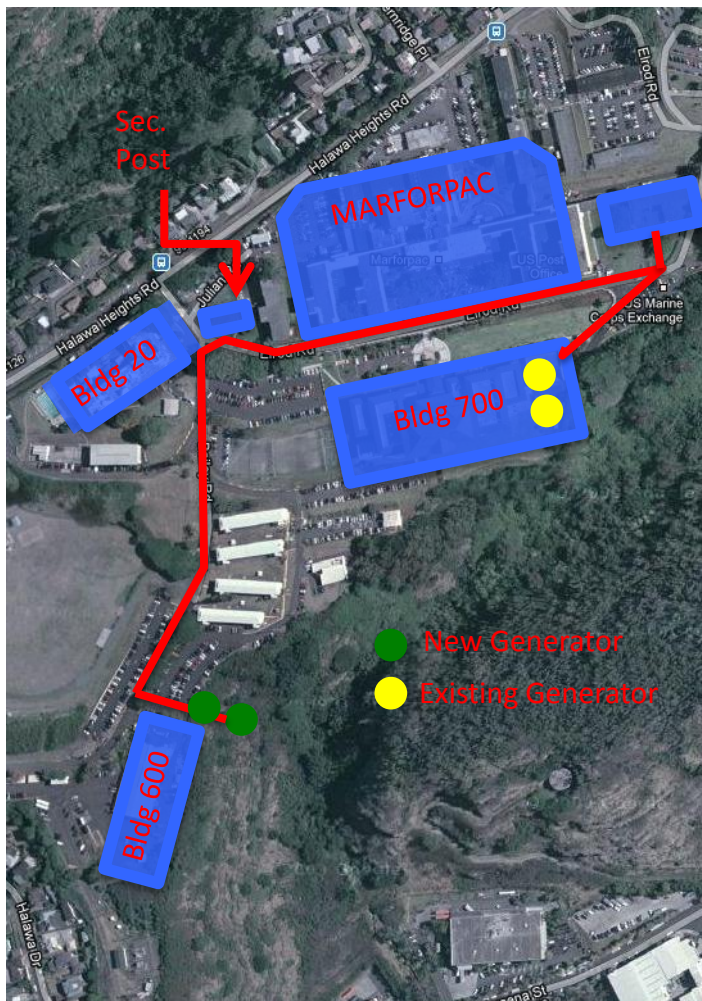
SPIDERS Phase 2 Progress



- **Construction Complete in Aug 2013**
- **4 Smith Electric Vehicles; 1 Vehicle from Boulder Company**
 - Successfully tested the bi-directional charging stations at National Renewable Energy Laboratory in Golden Colorado. Integration of the EVSE and Boulder vehicle has been completed on-site. Modeling of ISO market participation underway for ancillary service economic benefits. First vehicle-to-grid power tested.
- **1 MW Photovoltaic (PV) Solar Array Integration**
- **Concept of Operations (CONOPS) completed**
 - NORTHCOM completed CONOPS used in demonstrations and currently under final review
- **Cyber Security Requirements in progress**
 - Identifying SPIDERS control system owner. Working interim system accreditation, interim authority to test approved. Cyber experiment objectives, enclave and vulnerability assessment strategies ongoing
- **Technical Demonstration executed in Sep 2013; 74 hr Operational Demonstration performed in Oct 2013**
 - Enhanced reliability, diesel fuel savings, and reduced carbon emissions
 - Operational Utility Assessment Report to be released in Mar 2014
- **Cyber security testing still on going**



SPIDERS Phase 3 Microgrid Camp Smith, HI (PACOM HQ)



Fire Station



SPIDERS Phase 3 Progress



- **DOE Sandia National Laboratory (SNL) Preliminary Design Complete**
 - Initial conceptual **microgrid** design completed
- **65% Engineering Design Completed**
 - Design-bid-build contracting methodology
 - IDIQ design contract awarded to Burns & McDonnell (Phase 1 & 2 System Integrator)
 - 95% design by end of Feb 2014
- **Stakeholder Coordination and Design Meetings in Dec 2013**
 - Met with all local stakeholders and local utilities tenants at Camp Smith
 - SPIDERS microgrid siting integrated with Camp Smith master plan
 - Communications and fiber optic pathways available to meet critical path expectations
- **Construction RFP planned for Apr 14**
- **TD – Jan 15; OD – Mar 15**



SPIDERS Cyber & JBASICS Interactions



SPIDERS Cyber Framework



Implementation

DOE Sandia National Lab:

- Develops Cyber Security Reference Architecture (CSRA). Preliminary design (Phase 1 & 2) and mature design (Phase 3)

Army Construction Engineering Research Lab:

- Develops cyber security requirements in solicitation language for contract award

System Integrator (Contractor):

- Completes and builds microgrid network design based the CSRA. Supports system owner in accreditation

Experimentation/Assessment

PACOM:

- Conducts cyber red team experiments, confirms security network, demonstrate ability to score (Confidentiality, Integrity, and Availability), make quantitative/qualitative analysis

DHS:

- Conduct vulnerability assessment using the Cyber Security Evaluation Tool (CSET)

DOE PNNL:

- OD includes cyber assessment

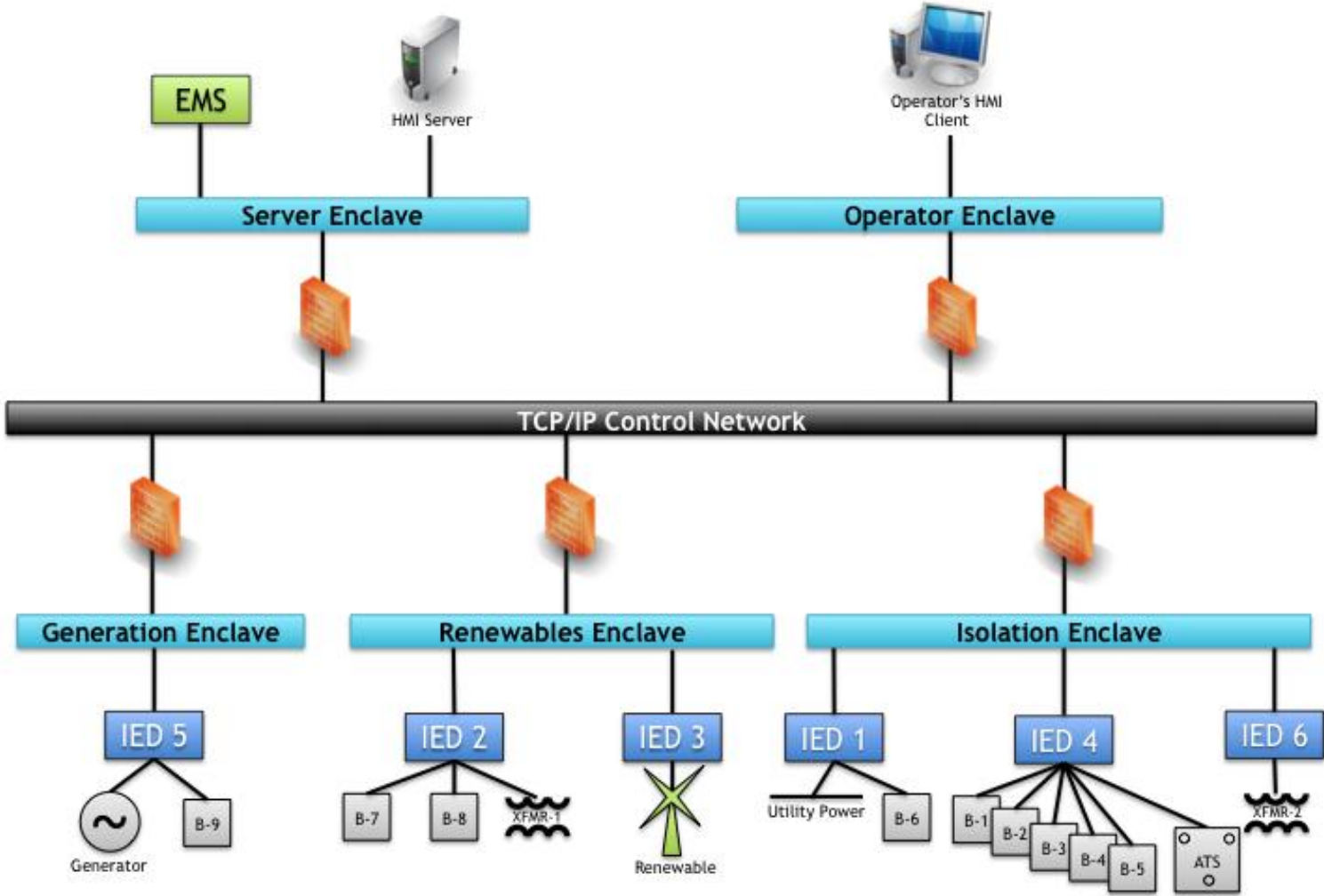
Transition

NAVFAC EXWC:

- Coordinates with ongoing Industrial Control Systems (ICS) cyber efforts
- Future integration into enterprise ICS network
- Provides data to OSD I&E to support DoD ICS cyber standards



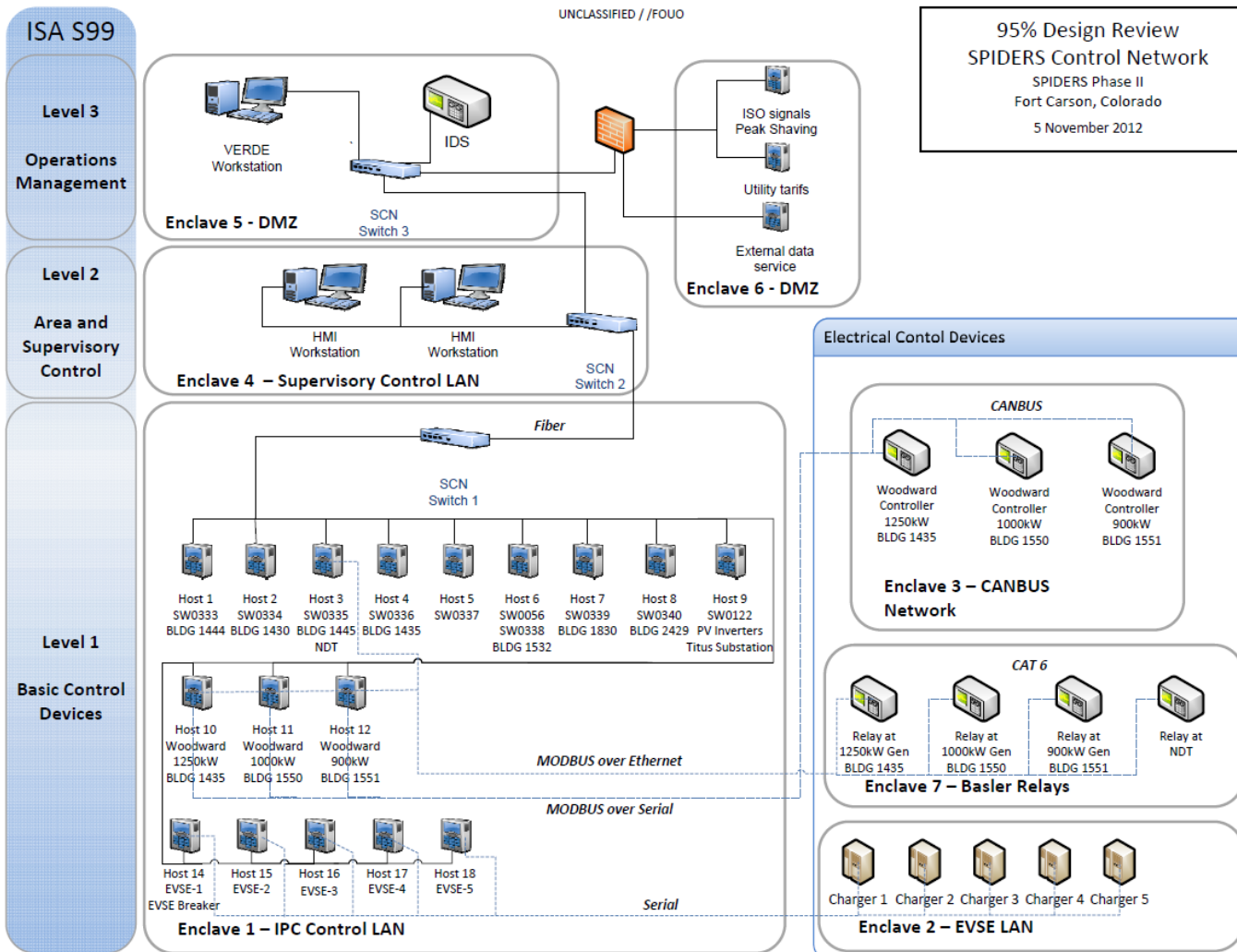
Sandia Reference Architecture Example



Reference Architecture (Enclave vs. Traditional Flat Network)



Phase 2 Implementation Reference Architecture



Three Levels, Seven Enclaves



Cyber Test Activities



Phase 2 Operational Demo (Oct 13)

- System accreditation
- DHS Cyber Security Evaluation Tool (CSET) evaluation
- Validation of the SPIDERS Reference Architecture

Phase 2 Cyber Experiment (Mar 2014)

- DOE PNNL performs static code analysis at vendor laboratory

Phase 2 Cyber Experiment (Apr 2014)

- Live cyber test on the Phase 2 microgrid

Phase 3 Red Team Experiment (Mar 14)

- Cyber red team experiment at the vendor laboratory (Boulder, CO)
- Results update Phase 3 final design

Phase 3 Operational Demo (Mar 15)

- DHS Cyber Security Evaluation Tool (CSET) evaluation
- Static code analysis

Phase 3 Cyber Experiment (Apr 15)

- Lab cyber test at the DOE lab in conjunction with JBASICS
- Nation state level (Classified)

Phase 3 Cyber Experiment (Jun 15)

- Live cyber test on the Phase 3 microgrid in conjunction with JBASICS



TTPs/CONOPS

Unclassified Level

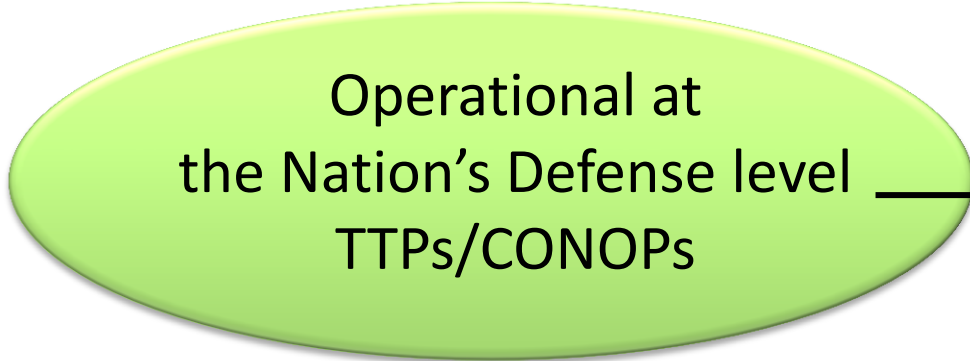
SPIDERS



DoD & Public Utility Operators

Classified Level

JBASICS



Cyber Warriors

- SPIDERS is a foundation that JBASICS uses to develop cyber defense TTPs/CONOPS for DoD
- JBASICS provides additional cyber testing to validate SPIDERS reference architecture at higher level
- JBASICS results will be provided as recommendations in the SPIDERS Camp Smith Transition Agreement resulting in a robust system for PACOM



Backup



Cyber Progress



Progress to Date:

- Initial experiment – Idaho National Lab National SCADA Test Bed, Aug 2010
 - PACOM-led with Sandia and Army red team attackers
 - Proved the concept with a simplified architecture
- Follow-on experiment – Sandia National Lab, Dec 2012 (Phase 1 lab test)
 - PACOM-led with Sandia and JIOWC red team attackers
 - Proved the value of network segmentation
 - Validated confidentiality, integrity and availability (CIA) scoring system
- Completed cyber experiment on live Phase 1 SPIDERS microgrid at JB Pearl-Hickam (Phase 2 live test)
- Phase 1 OD completed: passed the cyber security architecture tests (CSET assessment completed)
- Phase 1 network PRA accredited
- Phase 2 network design in progress - DIACAP accreditation in progress
- Phase 2 cyber experiment in progress (Phase 2 lab and live test prep)

Next Steps:

- Complete accreditation for Phase 2 systems
- Cyber experiments on Phase 2
- Update reference architecture for Phase 3 solicitation
- Cyber experiments on Phase 3
- Transition lessons learned via design guides, input to standards development, etc.