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Energy Surety Microgrid™ Design and Implementation Update

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Energy Surety Microgrid (ESM™) Project Update

Objectives

1. Use military bases to develop design approaches for upgrading energy infrastructure to increase cost-effectiveness, higher reliability, security, and sustainability
2. Use microgrid approach to design and implement energy distribution system improvements that meet above metrics

13 Bases evaluated – 30 microgrid designs

Life-cycle Funding Summary ($K)

FY09	FY10	FY11
$200K	$500K	$412K

Technical Scope

Use risk-based energy assessment to develop advanced microgrids:

- automated control of current and new distributed /renewable resources
- improve site energy infrastructure safety, security, reliability, sustainability
- enhance critical mission assurance and meet high priority loads

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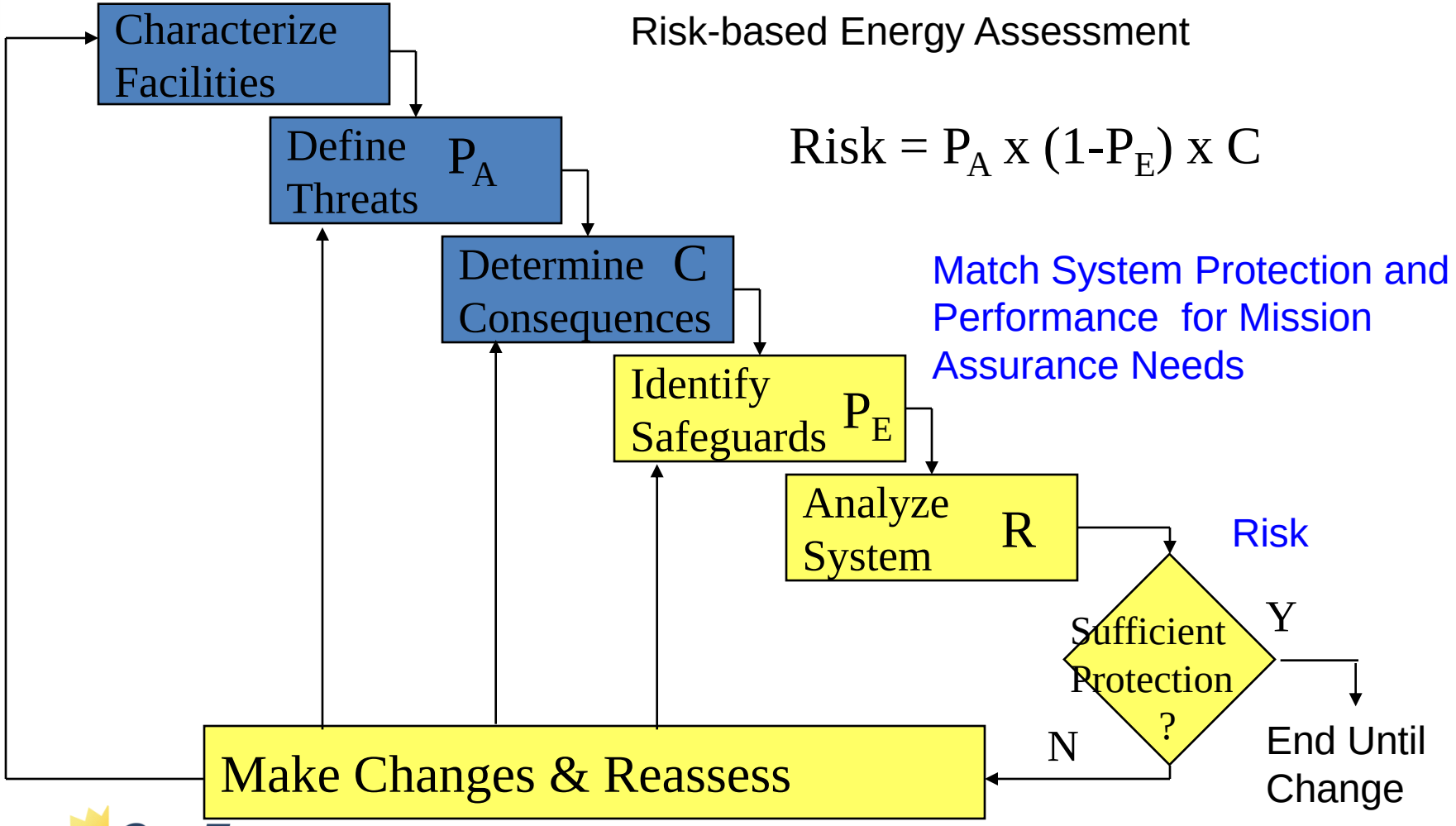
Background

- Program was initiated by DOE in FY09 to foster implementation of distributed generation at military installations to improve critical mission energy security and reliability
- Focus on advanced microgrids combining distributed generation sources with existing energy resources for 'grid-tied' and 'islanded' operations for critical mission assurance
- The advanced microgrid designs include:
  - Energy infrastructure and critical mission and priority energy needs assessment for extended outages,
  - Consequence and power flow modeling of distribution system upgrades to assess cost/benefit options,
  - Automated microgrid management, control, and cyber security

Technical Approach



Risk-based Energy Assessment

$$\text{Risk} = P_A \times (1-P_E) \times C$$

Match System Protection and Performance for Mission Assurance Needs

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Energy Security Challenges and Needs Identified

- **Bases are seeing as many as 20-100 power outages per year (vary from 5 minutes to 5 hours)**
- **Critical mission energy needs often not well understood**
  - Lack of backup generation for high priority needs
  - Lack of ability to address long-term outages
- **Consequence modeling shows that significant reliability and security improvements available with advanced microgrids**
  - Combined cooling, heat, and power (CCHP) easily possible and large energy savings
  - Automated microgrids show great flexibility - though control, management , and cyber security are concerns
- **Advanced microgrids able to operate "islanded" and "grid – tied" can greatly improve the ROI of distributed energy**
- **Multiple microgrids are often the best energy reliability approach at bases (coupling/networking can be more beneficial and cost effective)**

Sandia ESM Progress & Accomplishments

- **FY09 and FY10 ESM Conceptual Designs – DOE/DOE and DOE/FEMP Funded**
  - Ft Sill* (2)
  - Ft. Bliss* (2)
  - Ft. Belvoir (2)
  - 99th Air Guard (Ft. Devens) (2)
  - Ft. Carson*
  - Indian Head (2)
  - Camp Smith*
  - Maxwell AFB*
- **Five microgrids designs (*) in engineering design and construction**

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Sandia FY11 ESM Efforts

- **FY 11 DoD/DOE and DOE/FEMP Microgrid Conceptual Design Projects**
  - Philadelphia Navy Yard (3)
  - Cannon AFB (2)
  - Kirtland AFB (8)
  - Vandenberg AFB
- **SPIDERS program moving forward with three ESM designs and construction**
  - Ft. Carson, Hickam AFB, and Camp Smith
- **Coupled Kirtland AFB microgrid conceptual design selected for SERDP/ESTCP full proposal**

ESM Design and Implementation Progress

- **From Base Evaluations**
  - Advanced microgrid Concept of Operations CONOPS (draft) developed
  - Defining critical mission and priority loads
  - Developing military training manuals and guidance on advanced microgrids evaluation and design with USMA (West Point)
- **From SPIDERS program**
  - Tracking conceptual designs with three final designs to assess changes needed to accelerate advanced microgrid implementation
  - Developed microgrid cyber security strategy
    - DoD compliant, working on CyberCOM and NSA approval
  - Evaluating protective relaying design for safety
  - Integrated Dynamic Simulation Consequence modeling
    - Enables stakeholder input, webex based for critical and priority load assessment

ESM Design and Implementation Progress

- **From Maxwell AFB –**
  - Comparing semiautonomous and autonomous control complexity and performance cost/benefits
- **At Philadelphia Navy Yard and Kirtland AFB, developing integrated military/commercial and coupled military microgrids**
  - Assessing benefits of coupled and networked microgrid cost, performance, and reliability
- **At Ft. Belvoir, looking at cost performance benefits of advanced CCHP microgrids**
  - CCHP realistic consideration at 25% or more of bases assessed

ESM Tie with DOE Smart Grid R&D Program

- **Advanced Microgrid efforts support DOE Smart Grid long-term goals**
  - Supporting the ability to self-heal the distribution system and integrate DER and storage to improve energy safety, security, and reliability
- **Efforts will support the 2013 performance target of demonstration of a smart microgrid at a military base for >98% reduction in outage**
  - Efforts at Maxwell AFB, Camp Smith, Ft. Sill, and Ft. Carson are already moving to implementation, and others being designed to collect cost and performance data to assess outage reductions
- **With advanced microgrids should be able to meet the 2015 performance target of two integrated distribution management systems that reduce SAIDI by 5% or more**

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