Energy Exchange

Federal Sustainability for the Next Decade

U.S. Department of Energy

DoD Energy Resilience

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DoD Energy Resilience

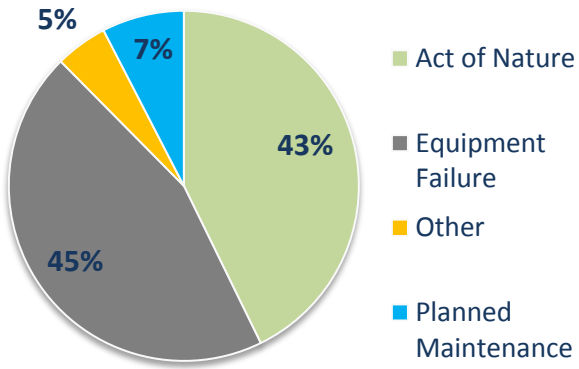
❑ Policy Drivers

- Multiple requirements through FY2017 NDAA;
- Title 10, Section 2925(a) (modified thru FY2016 NDAA);
- ASD(EI&E) Memorandum on Power Resilience;
- Department of Defense Instruction 4170.11, Installation Energy Management; and,
- Unified Facilities Criteria (such as Electrical Series).

❑ What are we doing now?

- DoDI 4170.11 change focused on energy resilience complete
  - Ensures performance against existing requirements
  - Encourages cost-effective solutions improving mission assurance
- Developing business case analyses (BCA) approaches to support/prioritize budgetary resources or alternative financing projects for energy resilience
  - MIT-LL study informs energy resilience BCA framework
  - Facilitates framework to quantify costs and availability/reliability

FY 2015 Utility Outages



Details on OASD(EI&E) Energy Resilience Initiatives:
http://www.acq.osd.mil/eie/IE/FEP_Energy_Resilience.html

DoD energy resilience is the ability to prepare for and recover from energy disruptions that impact mission assurance on military installations.

Energy Resilience Policy Overview

- DoDI 4170.11 policy includes the following energy resilience requirements:
  - Better define and describe 'critical' energy requirements for installations (coordinate collaboratively with tenants, missions owners and operators of critical facilities)
    - ✓ Track 4 Energy Resilience to Achieve Mission Assurance, Session 1: Energy Resilience Policy
    - ✓ Track 4 Energy Resilience to Achieve Mission Assurance, Session 3: Working Together to Achieve Energy Resilience: Energy and Mission Assurance
  - Continue to perform against already existing requirements: sizing of energy loads, maintenance, fuel, plans, and testing/exercising (principally generators)
    - ✓ Track 4 Energy Resilience to Achieve Mission Assurance, Session 1: Energy Resilience Policy
  - Encourage the most cost-effective solutions that improve mission readiness (allows for solutions beyond generators)
    - ✓ Track 4 Energy Resilience to Achieve Mission Assurance, Session 1: Energy Resilience Policy
    - ✓ Track 11: Integrated Energy, Session 5: Planning Large and Small Scale Microgrids and Smart Grids

Our Priorities: (1) Make sure the stuff you got will work (generators); and (2) think about smarter ways to support the mission (more resilient and will save money).

DoD Energy Resilience Study Problem Statement

Study Problem Statement: How does DoD meet current requirements for cost-effective and reliable energy resilience solutions for critical mission operations?

- To implement energy resilience solutions, DoD requirements include:
  - Prioritization of energy requirements to critical mission operations (in partnership with DoD mission assurance communities)
  - Pursuit of life-cycle cost-effective energy resilience solutions that provide the most reliable energy to critical mission operations
  - Reviewing energy solutions beyond typical backup or standby generators
- How does MIT-LL study help DoD address this problem?
  - Primary focus is to review cost-effective and reliable energy resilience solutions
    - Technology agnostic – focus on quantifying and optimizing cost and availability/reliability to critical mission operations
    - Aligned energy resilience solutions to prioritized critical energy loads for the military installations
    - Analysis of alternatives comparing current baseline (generators) vs. over 40 potential energy resilience options

Energy Resilience Overview
Critical Mission Operations (Enterprise-Level)

Critical Mission Operations (Sample - For Training Purposes Only)			
Global Intelligence, Surveillance, and Reconnaissance (ISR)	Power/Force Projection – Mobilizing, Deploying, and Demobilizing	Strategic Command Communication - Command and Control	Life, Health, and Safety Operations

❑ Overview:

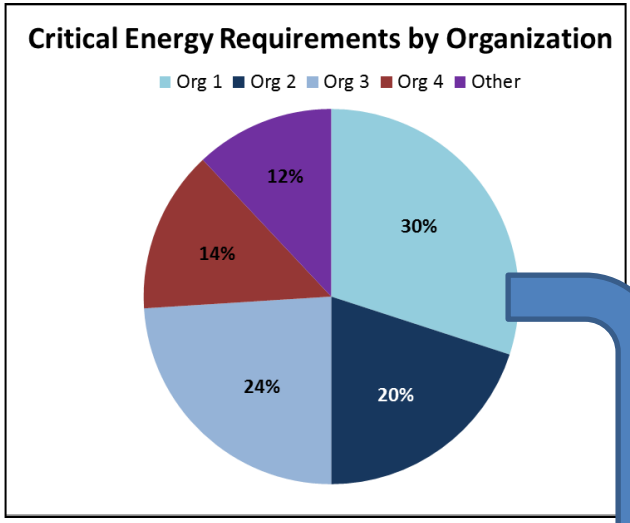
- Services and Defense Agency provided during power resilience review in 2014
- Validated through MIT-LL study was the need for a broader and integrated approach to develop an energy resilience framework, inclusive of:
  - Service and Defense Agency Warfighting Missions (Force Projection, Sealift and Port Operations, Air and Space Superiority, etc.)
  - Defense Critical Infrastructure (DCIs)
  - Emergency, Recovery, and Response Missions (DSCA, etc.)
  - Supporting Installation Infrastructure (those needed to accomplish critical mission operations and that consider outage-associated risks)

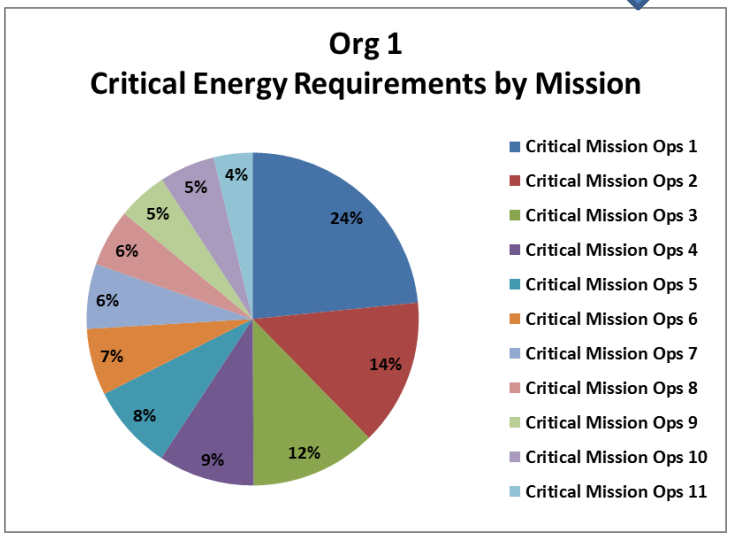
Important to establish an integrated and holistic energy resilience framework through collaboration and coordination between mission assurance and installation communities.

Results
Establishing Critical Energy Requirements

Organization	Total Energy (MW)	Critical Energy (MW)	% Critical by Org
Total	**10,000**	**2,500**	-
Org 1	3,000	750	30%
Org 2	2,000	500	20%
Org 3	3,000	600	24%
Org 4	1,000	350	14%
Other	1,000	300	12%

***Conceptual data for training purposes only.**



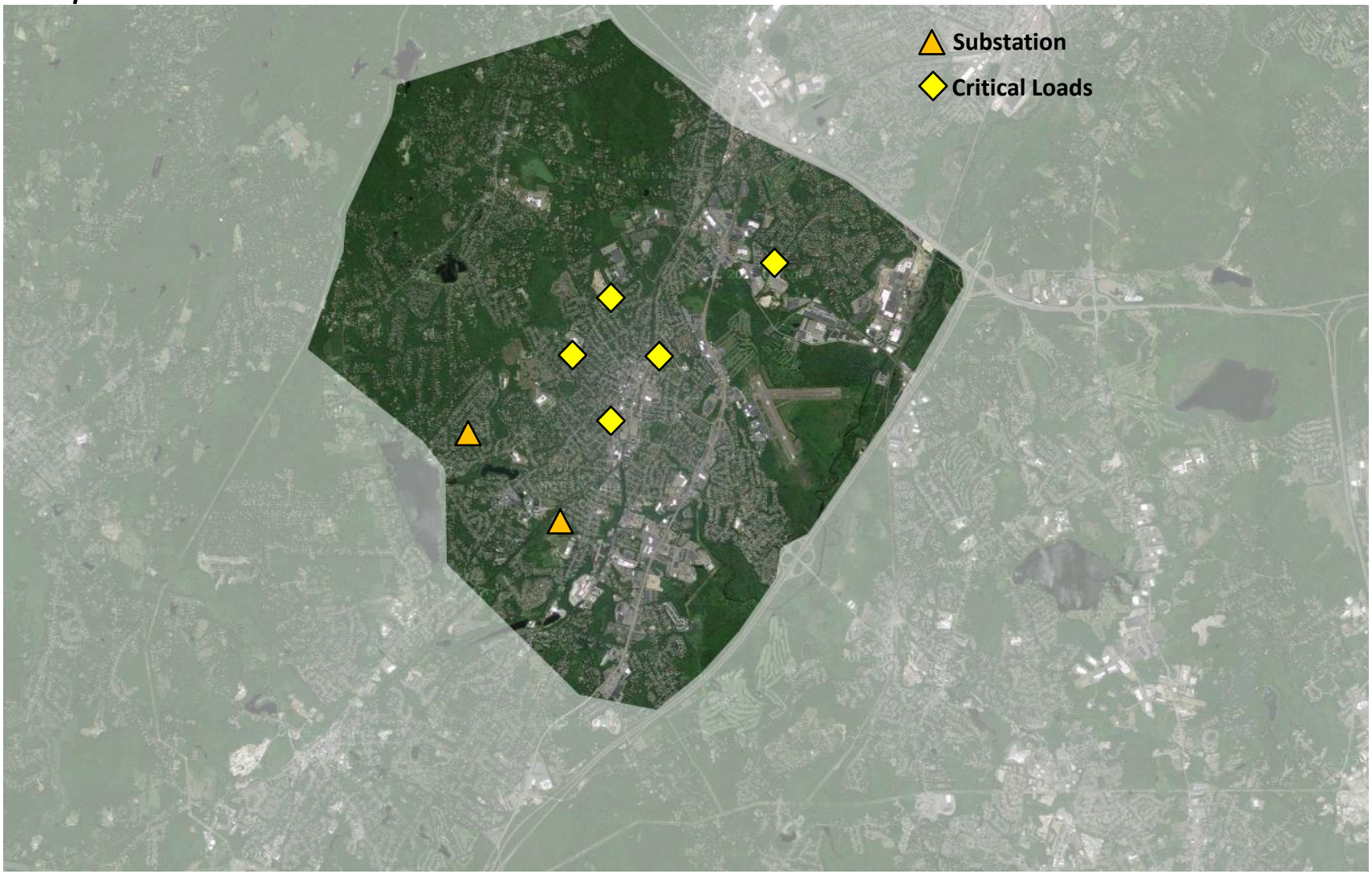


- First time we had identified and specifically quantified critical energy requirements
  - Alignment to critical mission operations by-installation
  - Established prioritization for energy resilience requirements and policy/compliance
- Good first attempt to quantify critical energy requirements to support mission assurance
  - However, gap was identified for initial sizing and specifically continuous sizing as mission adapts

Improving guidance to quantify energy loads that align to critical mission operations – encouraging continuous process to ensure appropriate sizing of energy generation with evolving missions.

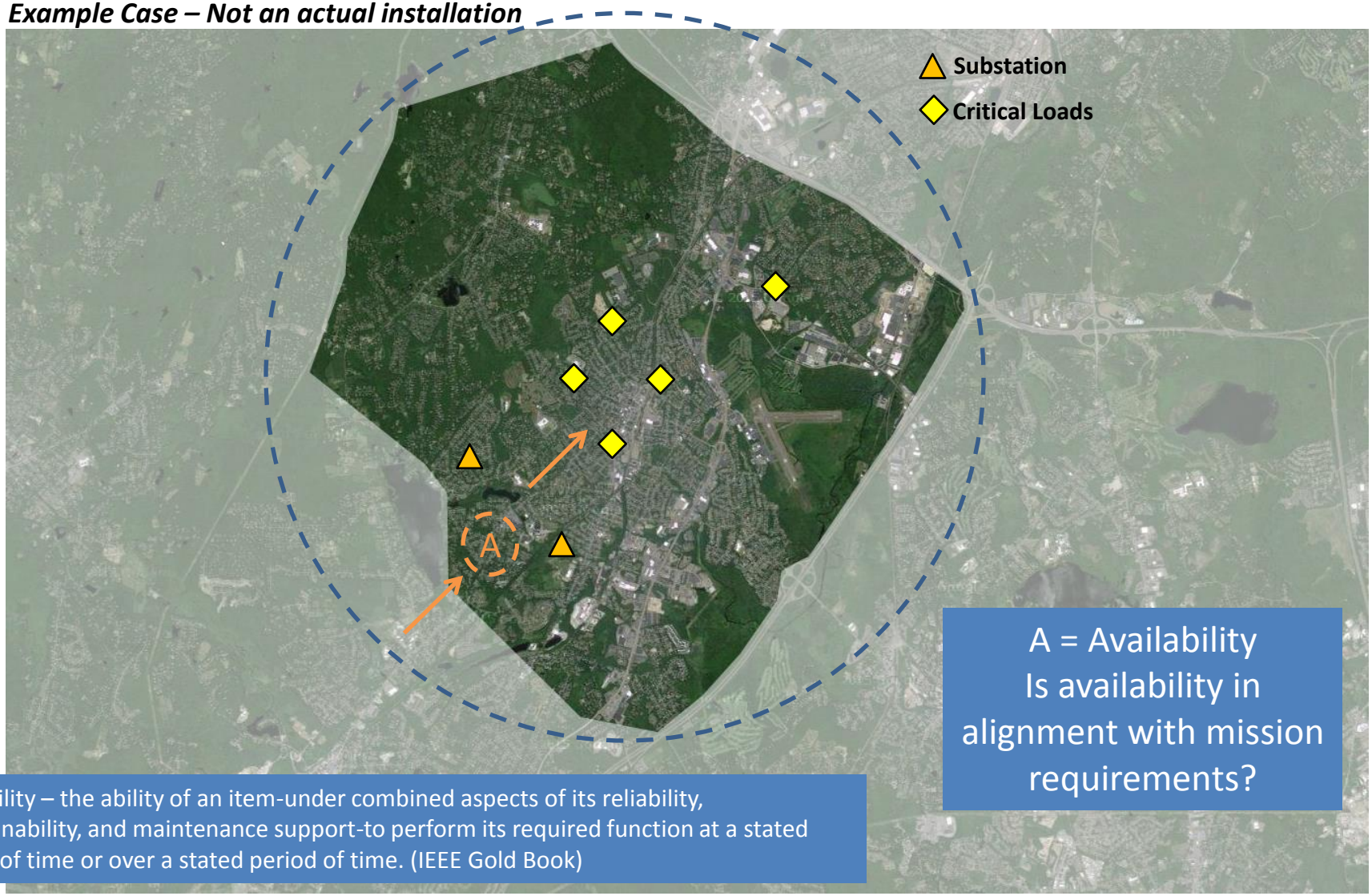
DoD Energy Resilience
Base-Level Critical Loads Example

Example Case – Not an actual installation



DoD Energy Resilience
Base-Level Critical Loads Example – Grid Impacts

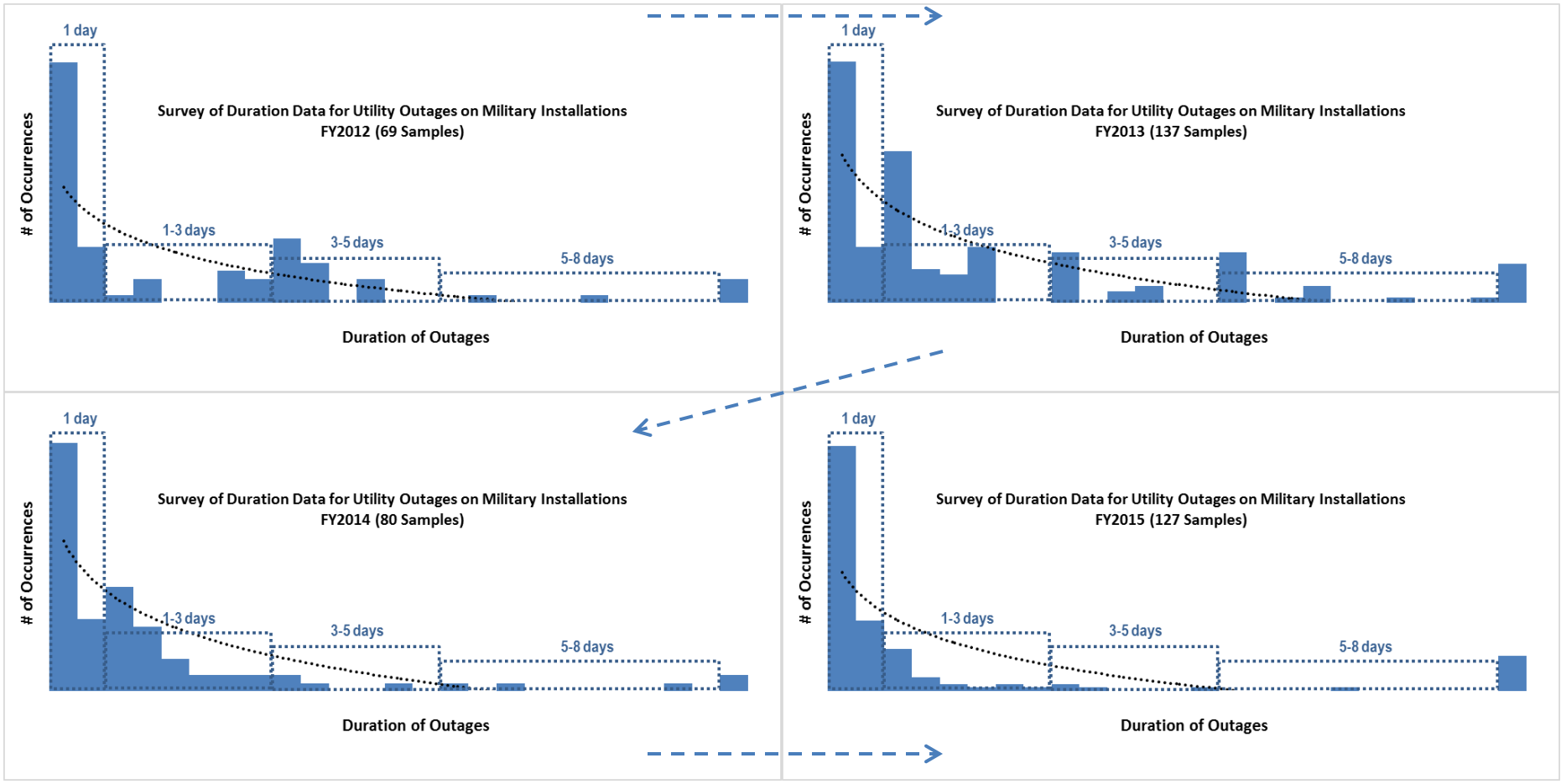
Example Case – Not an actual installation



A = Availability
Is availability in alignment with mission requirements?

Availability – the ability of an item-under combined aspects of its reliability, maintainability, and maintenance support-to perform its required function at a stated instant of time or over a stated period of time. (IEEE Gold Book)

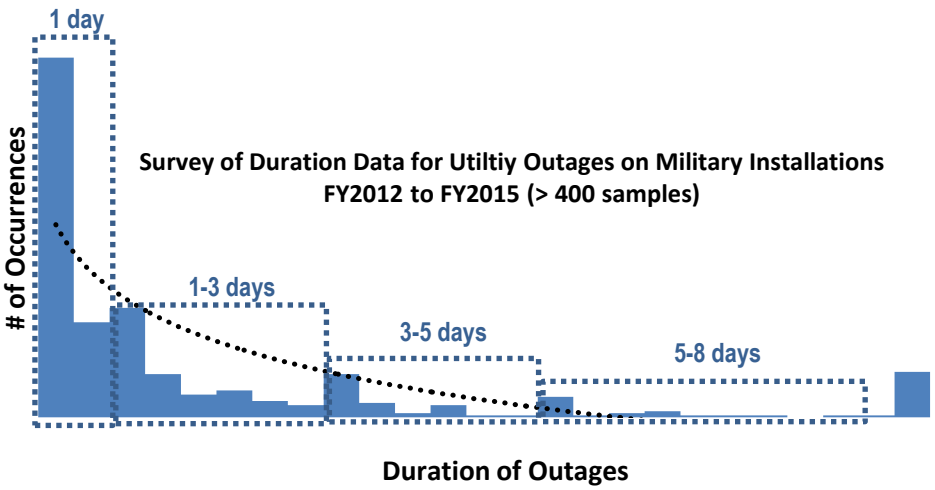
Duration Data for Utility Outages on Military Installations FY2012-FY2015



Data characteristics:

- Data request for outages 8 hours or longer
- Currently captures outages caused by off-base, commercial outages
- All outages caused by natural or reliability-related issues

Establishing a Baseline and Thinking about Risk Trade-Offs



- **Outage Duration Data Results**
  - ~ 55% lasted up to 1 day
  - ~ 80% lasted up to 3 days
  - ~ 90% lasted up to 5 days
  - ~5% lasted beyond 8 days

Most outages are of shorter duration and some may extend beyond 1 week.

* For training purposes, analysis performed on sampling of outage, generator, and fuel data.

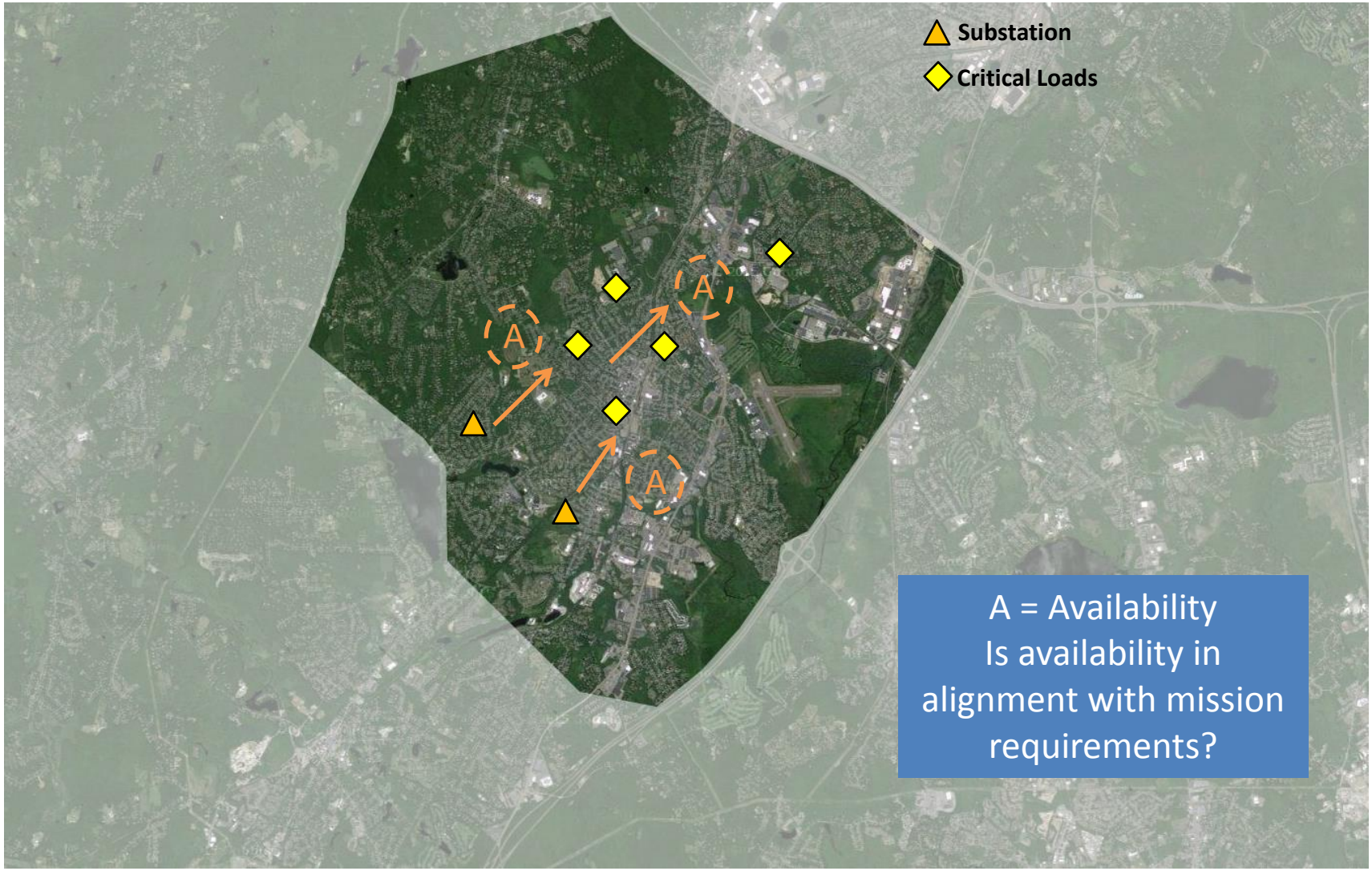
Analysis of Current State of Generators and On-site Fuel Supplies:

- On-site fuel supply fell between 1-2 day range at 100% load requirements
  - Current on-site fuel supply has potential to meet ~70% of historical outages
  - On-site fuel supply does not include additional fuel deliveries
  - If fuel deliveries extend to 1 week or greater, could potentially meet ~95% of historical outages
- However, are there are other solutions (beyond generators) that ensure or even improve mission assurance and do so cost-effectively?

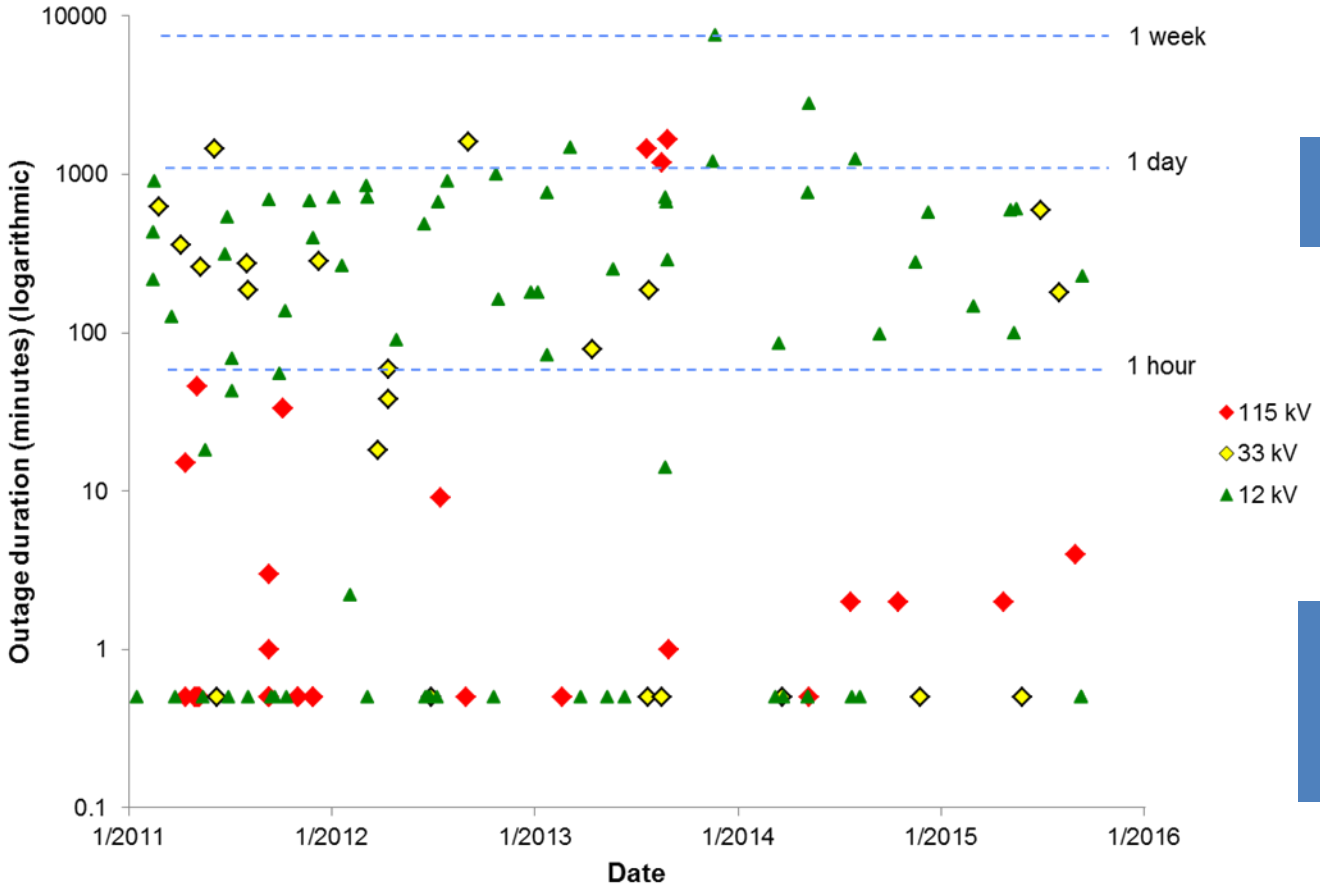
Ensure compliance with existing policies to remediate current risks today, but also think about more life cycle cost effective and reliable solutions to improve our energy resilience in the future.

DoD Energy Resilience
Base-Level Critical Loads Example – Base Impacts

Example Case – Not an actual installation



Sample of Historical Base-Level Outages (Availability Information)



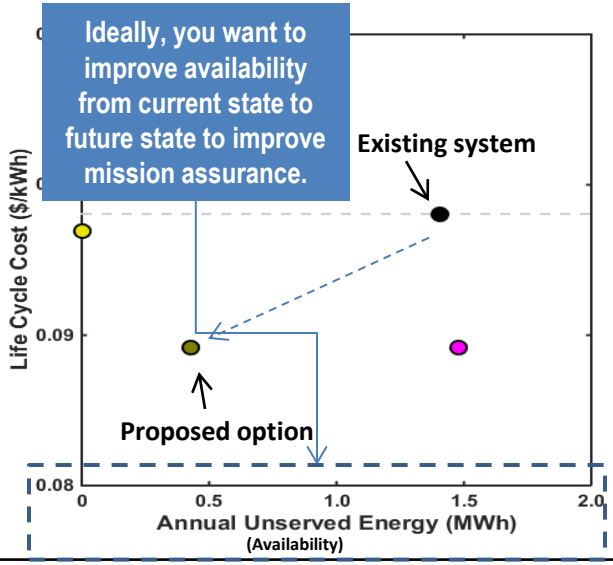
How does availability align to critical energy loads?

Is current level of availability sufficient to meet mission requirements at those critical energy loads?

Outage information at the distribution level on the installation could be an avenue to better align availability to critical energy loads and to mission requirements.

Bottom-Line Up Front (BLUF) Study Results Overview

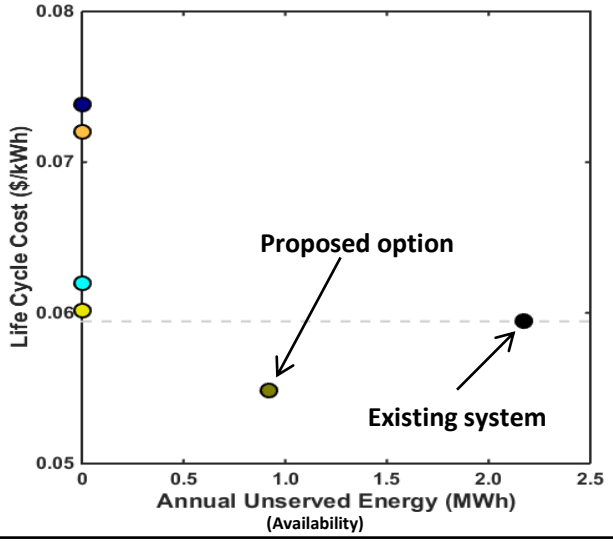
Cost attribute: life-cycle costs ($/kwh)
Mission attribute (availability): annual unserved energy (MWh)

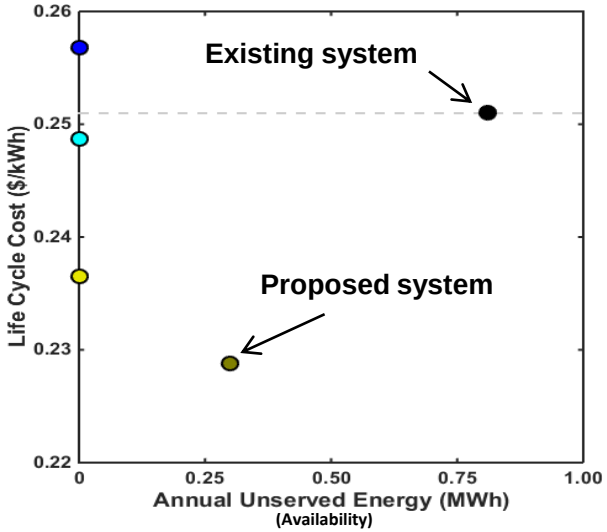


Findings/Results (generalized)

- Critical Energy Loads: 6 MW to 21 MW
- Generators: 50 to 350 generators
- Reductions in costs: 0.2¢/kWh to 2.2¢/kWh,
- Availability improvements: 0.3 MWh to 1.2 MWh
- Base characteristics: Isolated location with frequent outages, integrated/urban base with reliable power, etc.

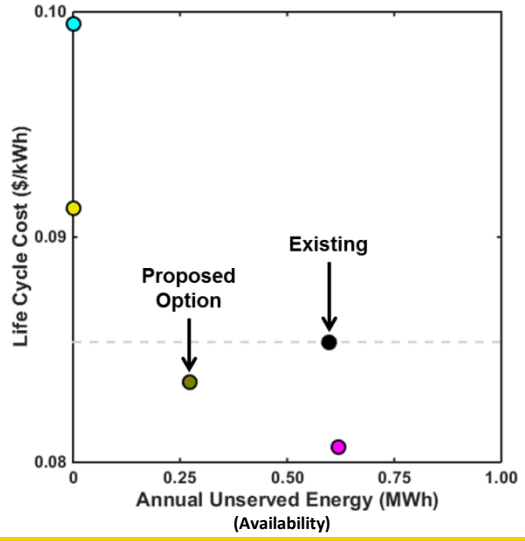
	Generator	Microgrid	UPS	PV	CHP	FC
●	x					
●	x	x	x			
●	x	x	x	x		
●	x		x	x		
●	x			x		
●	x	x		x		
●	x	x	x	x	x	
●	x	x	x	x		x
●	x	x	x	x	x	x





Framework allows for quantifiable tradeoffs between cost and mission assurance attributes.

Results across diverse bases indicate that more cost-effective and reliable energy resilience solutions exist to support critical mission operations on our military installations.



DoD-Wide Recommendations

Sampling of Findings

Important to collaborate mission requirements between mission assurance and installation community to achieve energy resilience.

- **Communication**
  - Encourage routine meetings between installation energy leads and mission operators to determine and prioritize 'critical' mission operations and energy requirements across the entire base
    - Improve guidance to determine prioritized energy load calculation for critical mission operations
  - Coordinate with the community (inside and outside of the base) to ensure critical interdependent mission requirements are met during energy outages
- **Technical**
  - Understand your current energy systems and infrastructure; do not site energy systems on unreliable grid
  - Prioritize/ensure energy resilience systems are only placed on critical energy loads and not oversized
  - Standardize a process to ensure O&M of energy systems (e.g., generators, UPS, etc.) for full reliability picture
- **Cost and Performance Data**
  - Encourage tracking of the appropriate cost data (capital, operation, maintenance, and testing) of energy generation and infrastructure to replicate and justify the business case for future energy resilience solutions
  - Encourage tracking of performance data that aligns to mission and availability/reliability of energy systems and infrastructure (outage data, failure rates, etc.) to assist in tradeoff decisions between cost/mission
    - Helps to identify cost-effective and prioritized remediation of reliability risks that align to mission requirements

Collaborating with Services and Defense Agencies to raise awareness through future guidance across the DoD.