Resiliency in Military Planning and Design:
New Technologies Enliven Old Ideas

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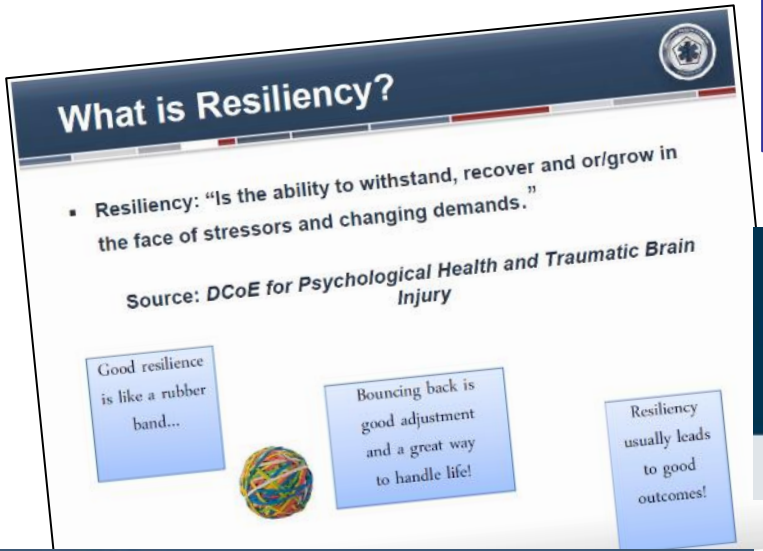
Overview

1. What is resilient design and resilient facilities?
2. A few “old” idea with renewed purpose

   From planning to resilient design

   - AFSOC in Japan
   - 920th Rescue Wing in Florida

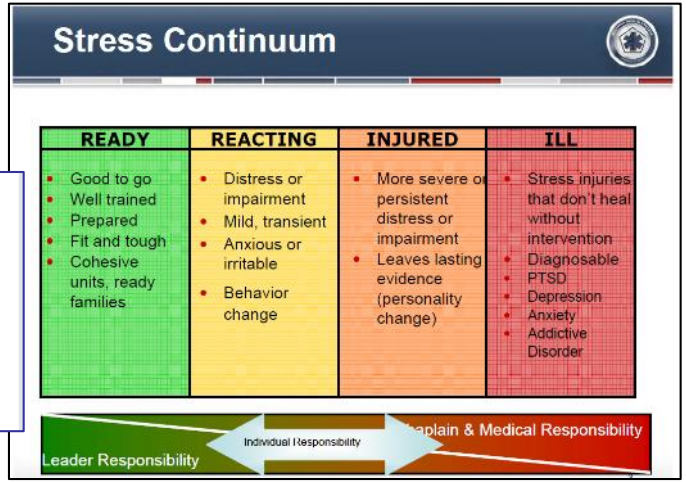
You mean this resiliency?



PSYCHOLOGICAL AND EMOTIONAL WELL-BEING

Key Products and Topic Areas

- Resilience



NAVY AND MARINE CORPS PUBLIC HEALTH CENTER
PREVENTION AND PROTECTION START HERE

Headquarters Air Force Resiliency Division

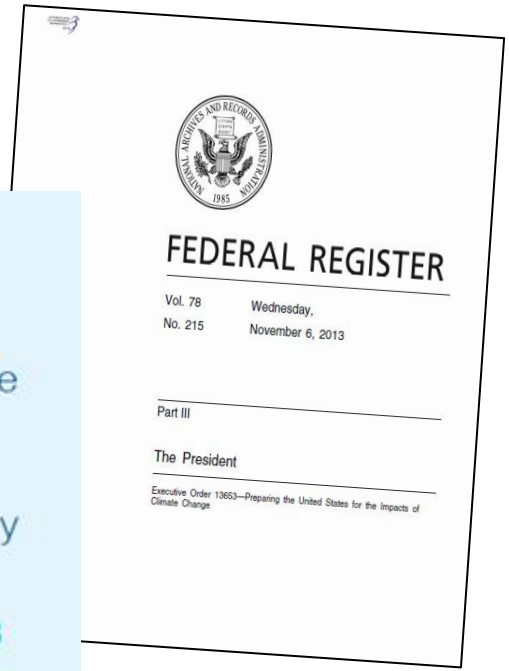
READY RESILIENT
Achieving Personal Readiness. Optimizing Performance.

1 Resiliency

RESILIENCE DEFINITION

The term "**resilience**" means the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.

– E.O. 13693


FEDERAL REGISTER

Vol. 78 No. 215 Wednesday, November 6, 2013

Part III

The President

Executive Order 13653—Preparing the United States for the Impacts of Climate Change

- *Resilience* - the capacity to adapt to changing conditions and to maintain or regain functionality and vitality in the face of stress or disturbance. It is the capacity to bounce back after a disturbance or interruption

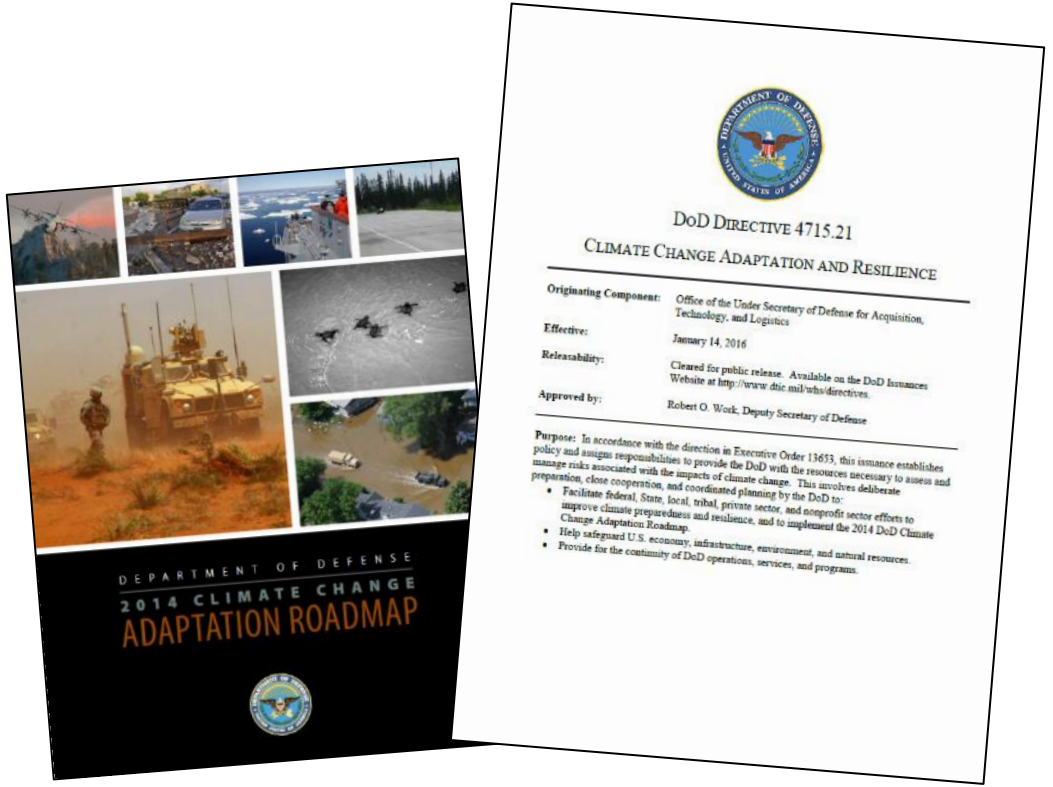
per the Resilient Design Institute (RDI)

DODD 4715.12 - Climate Change Adaption and Resiliency

ENERGY SECURITY DEFINITION

The term "**energy security**" means having assured access to reliable supplies of energy and the ability to protect and deliver sufficient energy to meet operational needs.

– 10 U.S.C. 2924



Army Directive 2017-07, Installation Energy & Water Security Policy

- 14 day water and energy supply to critical mission facilities
- Infrastructure capable of onsite energy and water storage
- Flexible, redundant distribution networks
- Trained personnel in sustainment for energy and water security
- Plan, program, budget and execute energy and water projects that close energy and water security gaps and reduce risk

Provide a Life Boat

"Create community facilities (resilience hubs) that can serve as gathering places during emergencies and interruptions in services, and outfit such facilities with access to key services, including water, electricity for charging cell phones, etc. Such capabilities could be integrated into schools and other existing community facilities." -- Resilient Design Strategies, RDI

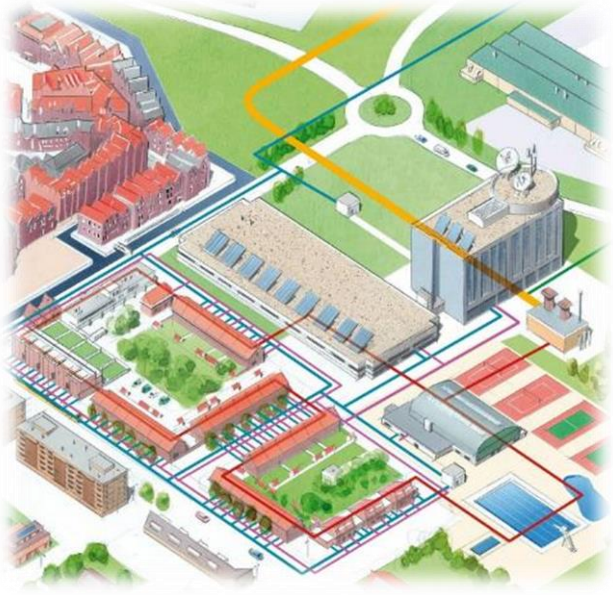
Resilient Design Strategies

Infrastructure

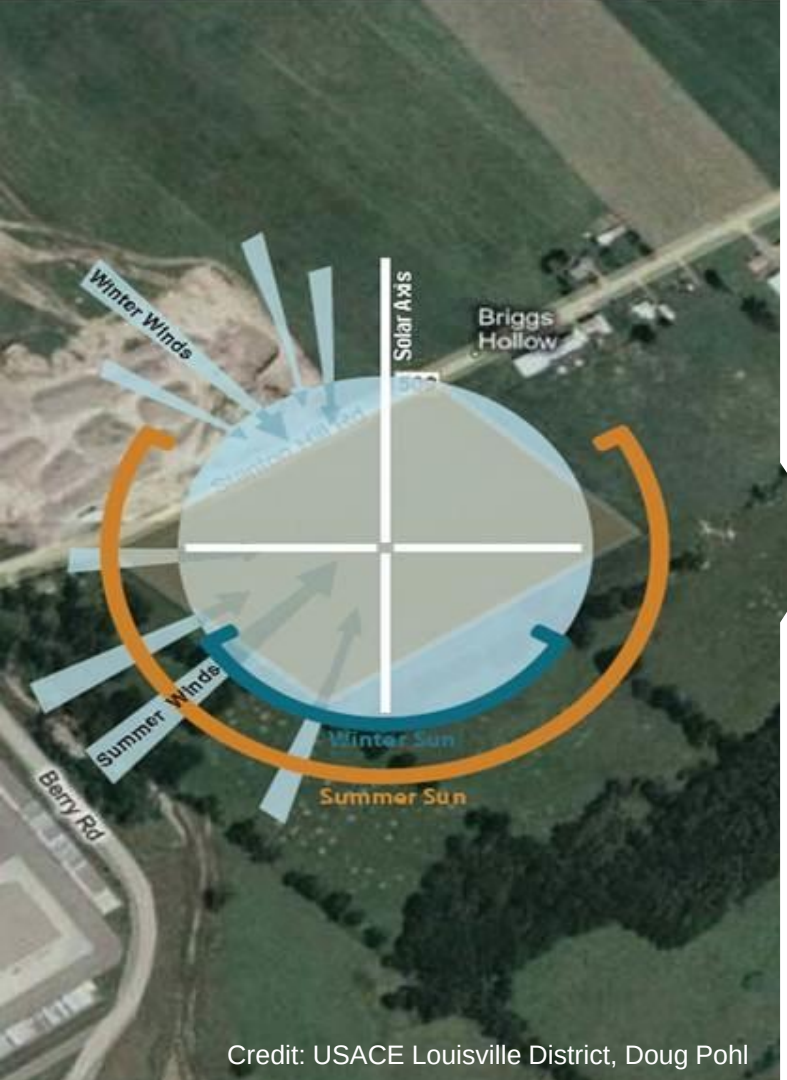
- Transportation – multi-modal
- Communication – multi-modal as well
- Energy – distributed power; smart/micro-grids; local
- Water – distributed storage and treatment
- Intelligent/smart controls

Buildings

- Extremely efficient
- Local power and water, with local control
- Include storage – thermal, water, power
- Passive heating/cooling & ventilation
  - Orientation
  - Operable windows



…are often most (or *only*) effective at a community, district or campus scale



Credit: USACE Louisville District, Doug Pohl

Resilient design starts with site analysis and planning

- What are your risks, present and future?
- What are your assets?
  - Solar, wind, soil characterization
  - Water/hydrology and energy flows
- Model using future climatic conditions rather than past
- Locate critical systems to withstand extremes

Resiliency for AFSOC in Japan

2

ASIA

Okinawans Protest Deployment Of U.S. Osprey

October 2, 2012 · 4:00 AM ET
Heard on Morning Edition

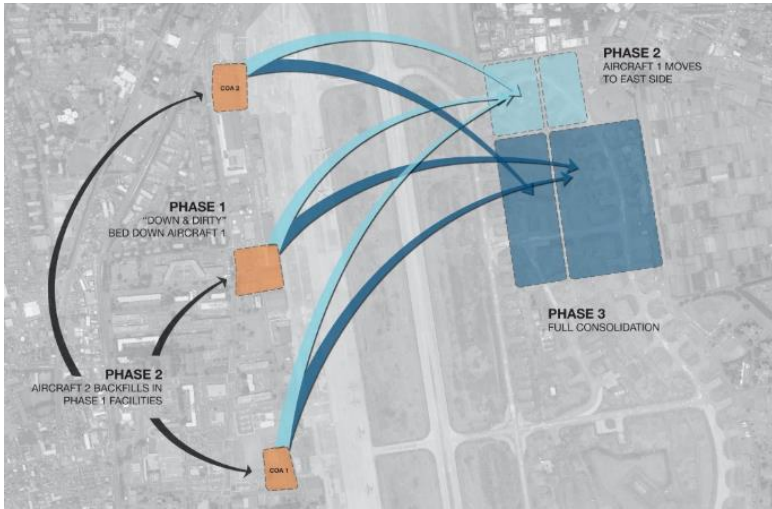
LUCY CRAFT

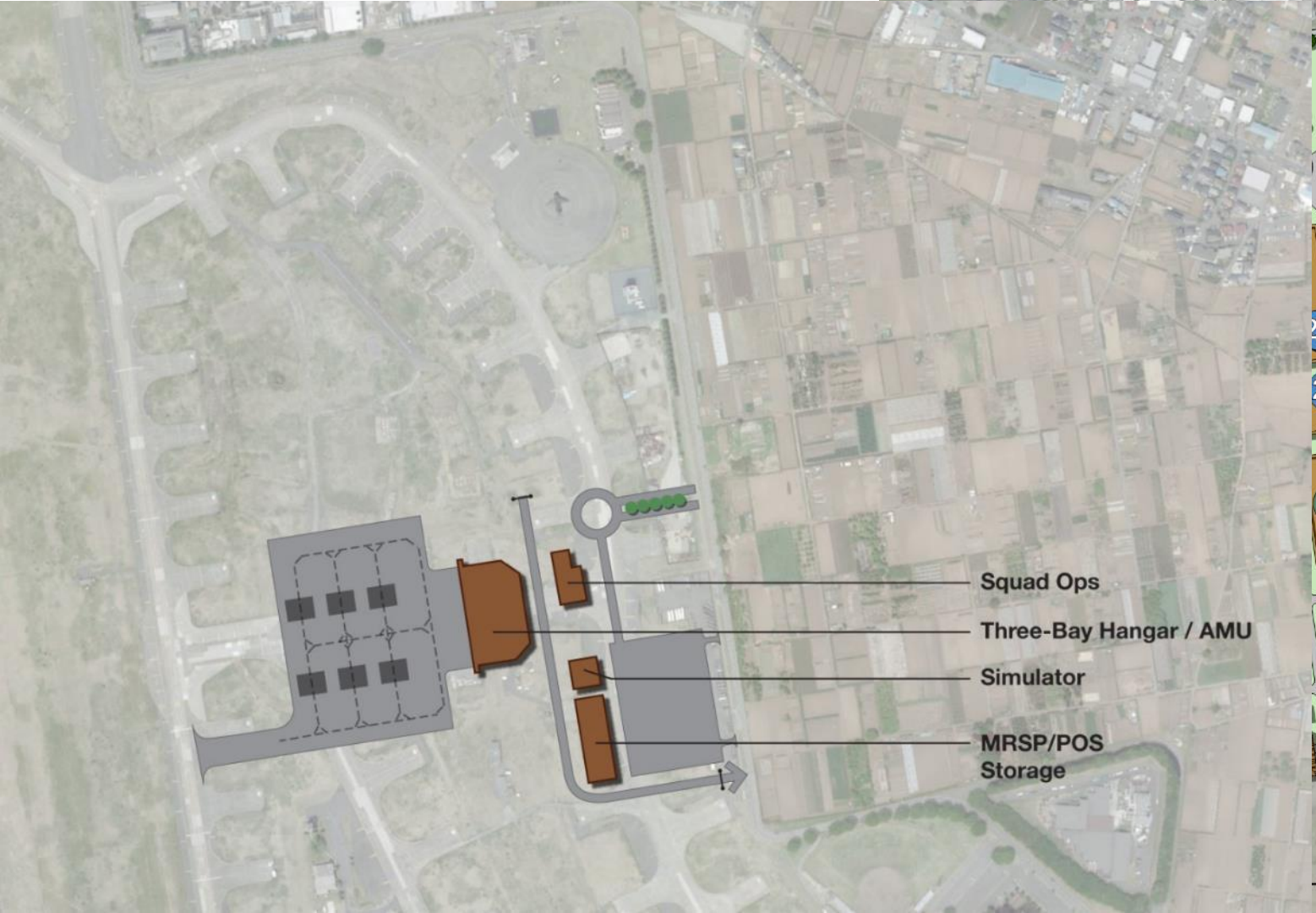
An Osprey arrives at U.S. Marine Corps Air Station Futenma in Ginowan city on Japan's southern island of Okinawa on Monday. Six Ospreys were deployed in Okinawa, drawing sharp reactions from residents amid persistent concerns about the aircraft's safety.

JIJI Press/AFP/Getty Images

Plan for a new mission…

- Create an Area Development Plan (ADP) for Air Force Special Operations Command (AFSOC) “Plan B” airframes at Yokota AB
  - Sep 2013 – Sep 2014
  - AE Team = 5 people
  - Alternative Development Scenarios
  - Short- and Long-Range Plans
  - Phasing, Cost Estimates and 1391’s




Squad Ops
Three-Bay Hangar / AMU
Simulator
MRSP/POS
Storage


DASR
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Long-Range Requirement	Program Amount	Scope
Simulator Facility	$15.5M	~11K SF
Airfield Apron	$25.3M	~457K SF
Hangar/AMU	$54.8M	~76K SF
Squadron Operations		~21K SF
Aircraft Parts & MRSP	$42.4M	~33K SF
Group Headquarters		~5K SF
Campus Development	$138M	~50 Acres

Next step: User Requirement Documents

- To justify future facility acquisition & verify PAs
- Effort included providing revised DD1391s
- Enter resilient design…

Resilient Design Ideas

Professional work environment

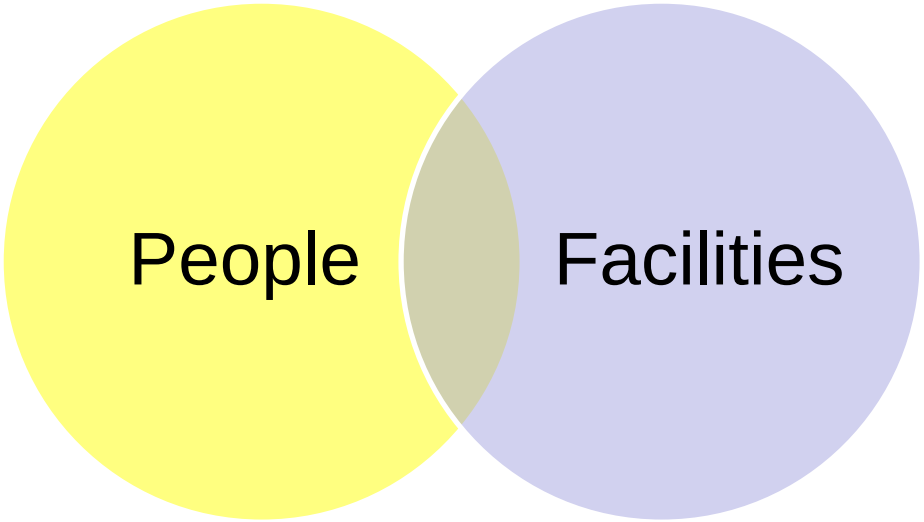
Unity & Purpose

Places of Respite

Sense of Place

Positive impression off-base

Safety & Comfort



Maintainable

Life-cycle cost effective

Energy efficient buildings

Redundant energy supply

Site adapted features

Low impact development

3

Resilient Design Strategies (with example)

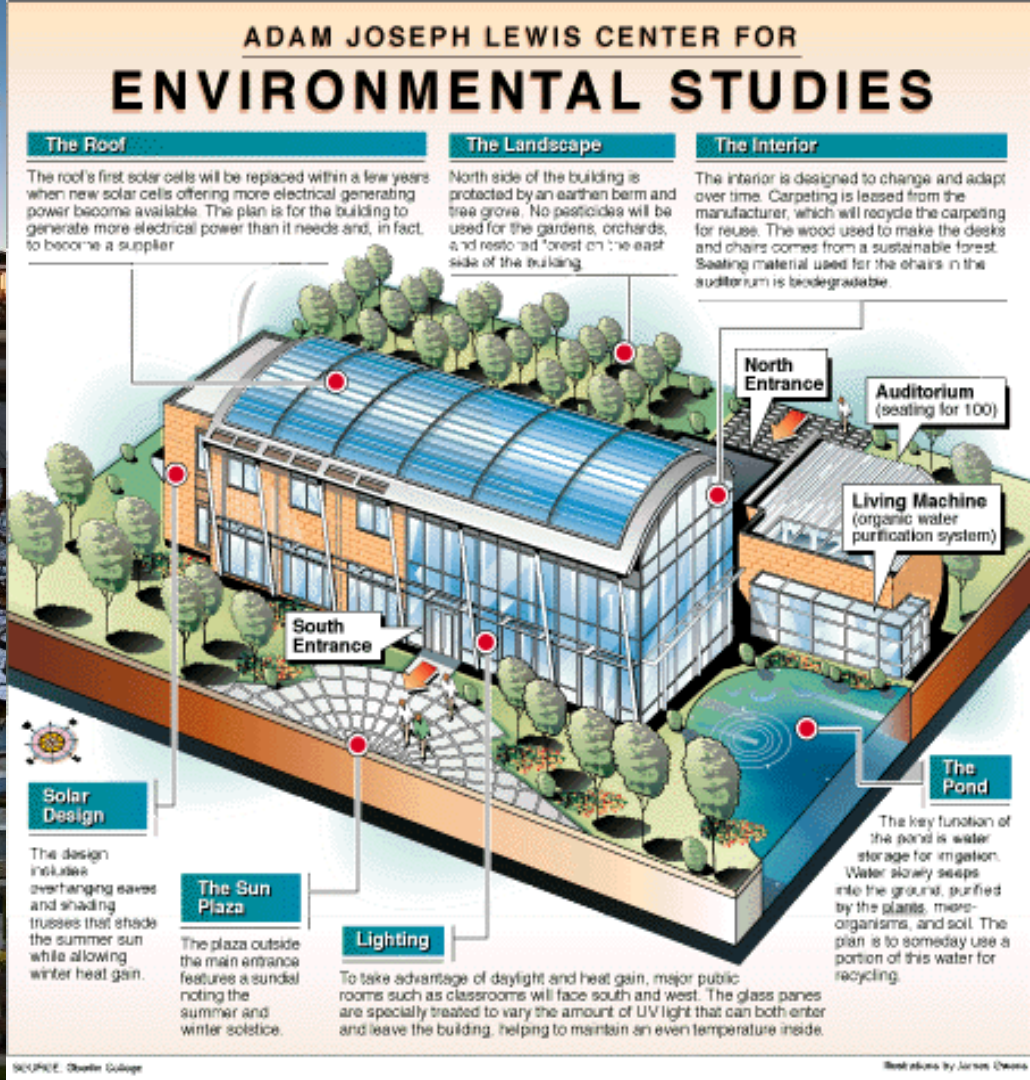
Old idea find new relevance…

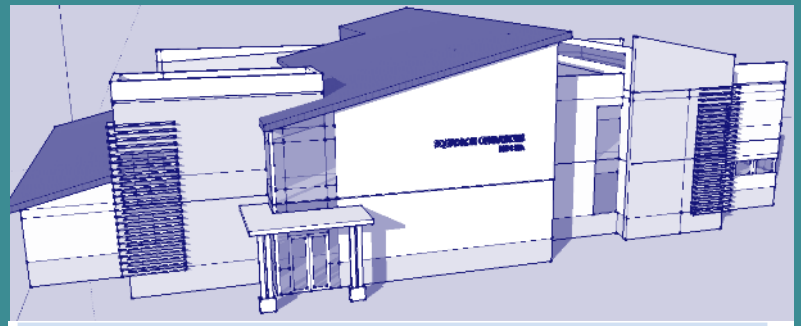
3.1 High-Performance Buildings

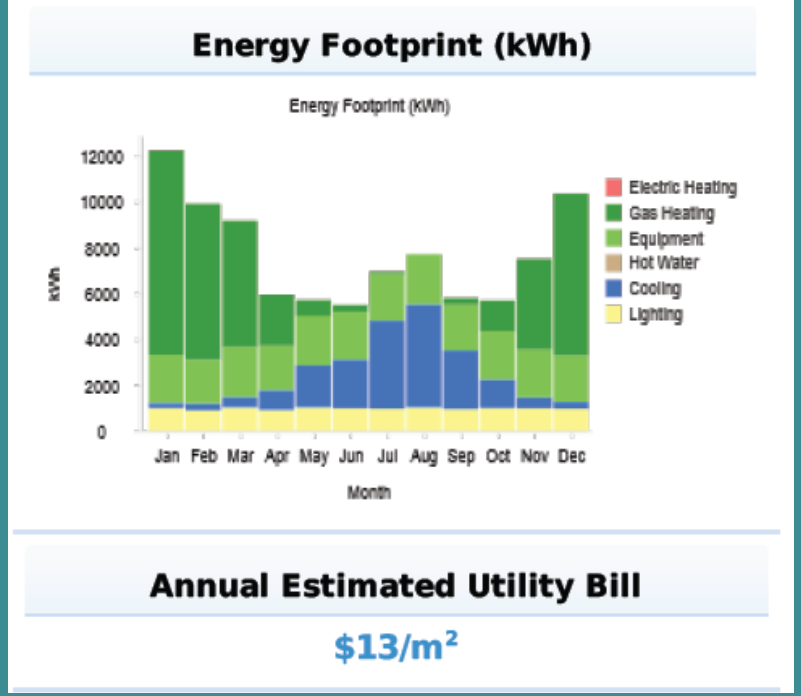
- Why you already used them?
  - Energy and water savings
  - Enhanced indoor environmental quality
- How are they also resilient?
  - Extreme efficiency necessary to make on-site storage and generation sufficient in times of need
  - Passive design features allow continued operations during outages
    - Daylighting
    - Operable windows, stack ventilation
  - *Vernacular design*: practices prevalent before the advent of air conditioning and central heating

Research Support Facility, Golden CO
Net-zero Energy

Bullit Center, Seattle WA
Living Building Challenge







High Performance Building (Modeling)

- Designed to 30%+ efficiency over 90.1-2010
- 57% of interior spaces daylit
- Maximized PV potential of south-facing roof
  - Could provide 35% of energy; 50% of cost

3.2 On-site (Central) Plants & Generation

- Why you already used them?
  - Peak load shedding to save money
  - More energy efficient generation
  - Reduced staff and maintenance burden compared to distributed systems
  - Diversity of energy supply
- How are they also resilient?
  - If set up correctly, they can “island” during grid outages
  - Provide self-sufficiency during utility/infrastructure failures
- Through a resiliency lenses…
  - Caution: don’t create a single point of failure either

Princeton on October 30, 2012. *(Tony Kurdzuk/The Star-Ledger)*

Princeton & Sandy

- Resilient design strategies
  - On site co-generation
  - Electrical microgrid
- University became a “place of refuge”
  - Community members could warm up, charge cell phones, use wireless, etc.

Solar Ready Design

- Estimated energy use intensity (EUI) of buildings
  - Est. 883 MWh/yr
  - Equiv. to one acre of PV
- PV in conjunction with microgrid & generators to provide resiliency

Solar-Ready Design

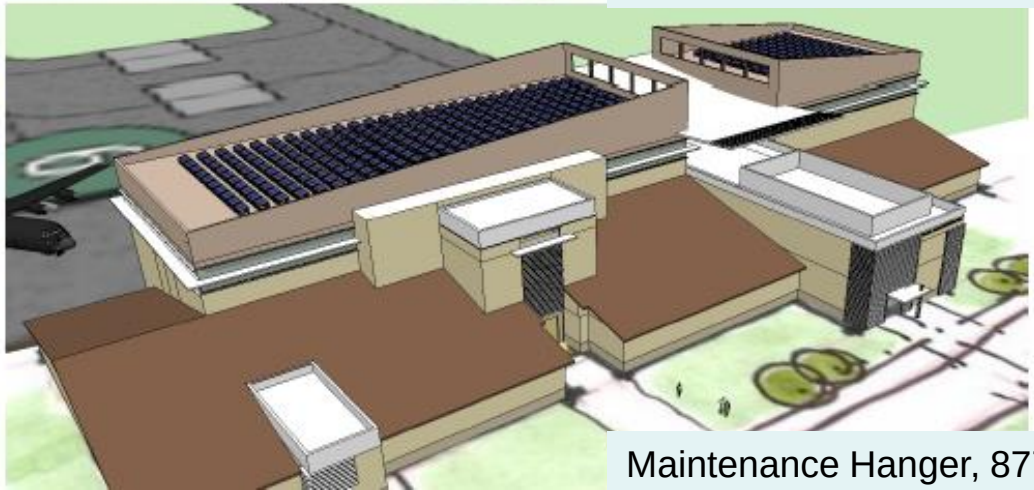
- Turned the warehouse, re-designed roofs
- Increased south-facing roof area to 67,823 SF
- Increased the solar potential ten fold

PV-ready design…

Warehouse, 8570 sf

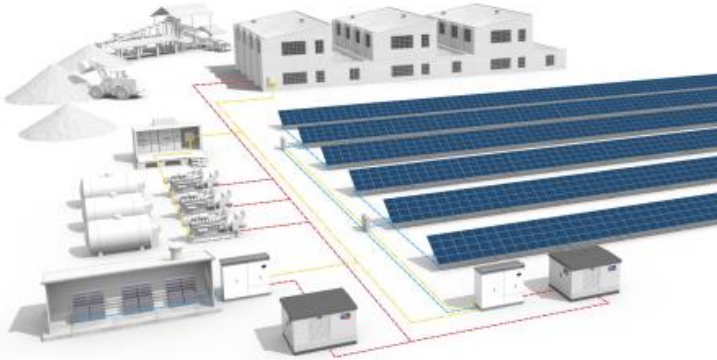
Admin Building, 1340 sf

Admin Building, 1344 sf



Maintenance Hanger, 8778

3.3 Micro-Grids



- Why you already used them?
  - Enables smart-grid implementation
    - Two-way communication and control integral to the grid
  - Enables “demand response” energy strategies
    - Allow utilities to power up or down equipment in times of need = $$ savings
- How are they also resilient?
  - Makes “islanding” during grid outages possible
  - Provide self-sufficiency during utility/infrastructure failures
- Through a resiliency lenses…
  - Caution: cybersecurity is key

Micro-Grids

- Improve reliability
- “Island” critical infrastructure
- Accommodates local, distributed generation
- Resiliency principle: allows *diversity and control* of energy supply
- Starts with planning

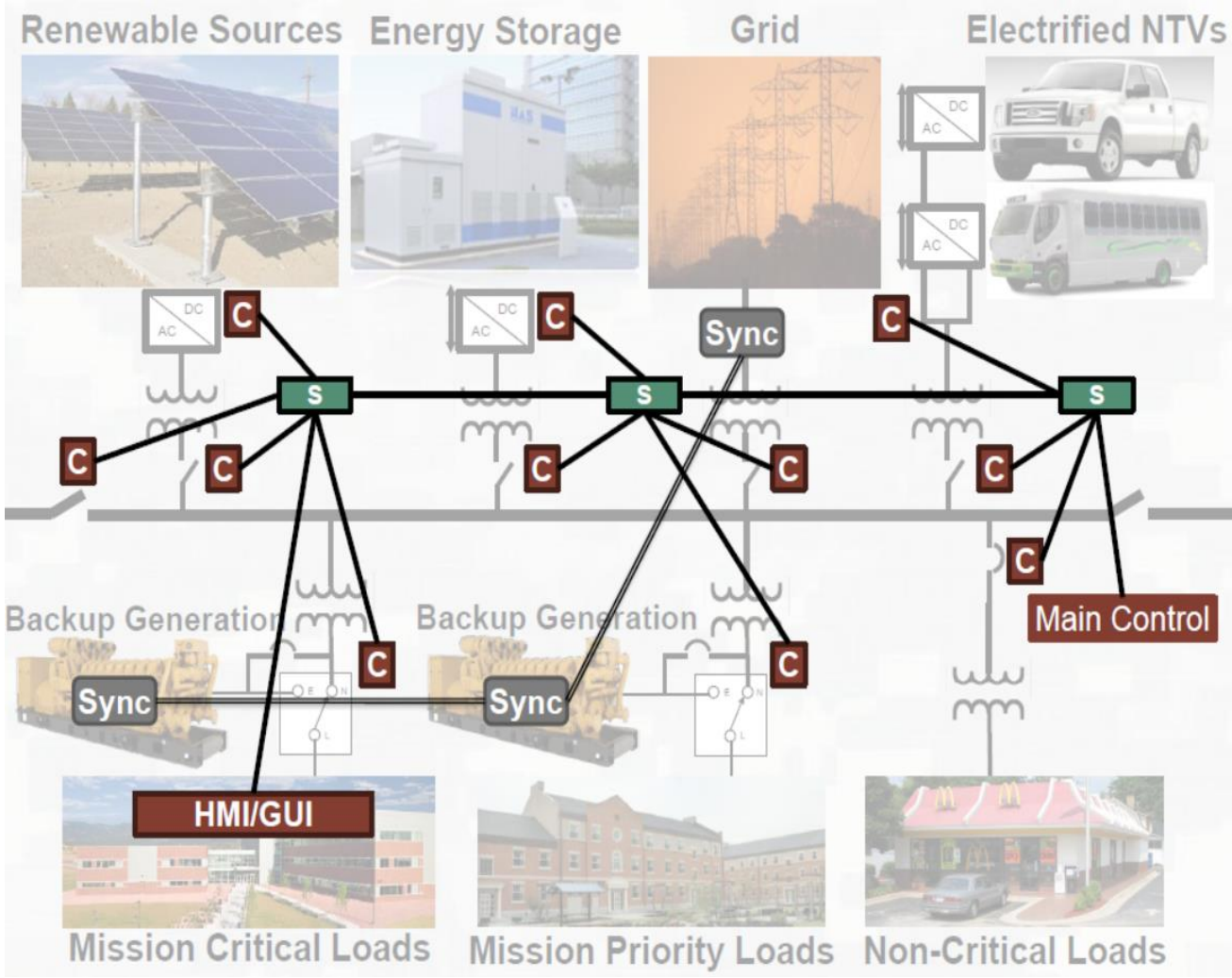


Photo credits: Melanie Johnson, USACE ERDC-CERL

SPIDERS

SMART POWER INFRASTRUCTURE DEMONSTRATION FOR ENERGY RELIABILITY AND SECURITY

SPIDERS Participants

ERDC Engineer Research and Development Center

NAVFAC Naval Facilities Engineering Command

TARDEC

US Army Corps of Engineers

U.S. AIR FORCE

U.S.ARMY

Sandia National Laboratories

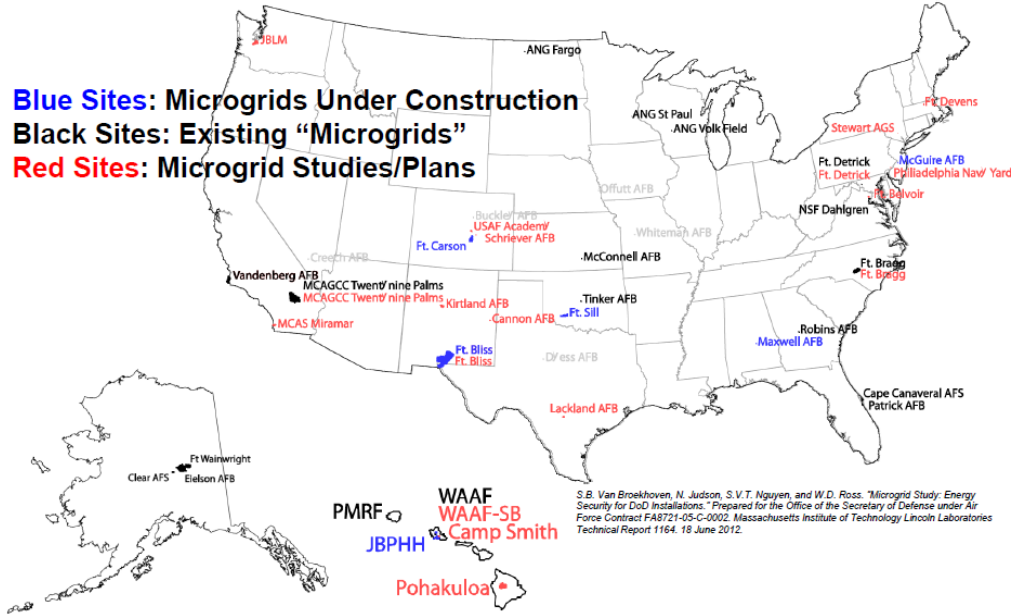
Pacific Northwest National Laboratory

NREL

Oak Ridge National Laboratory

INL

Blue Sites: Microgrids Under Construction
Black Sites: Existing "Microgrids"
Red Sites: Microgrid Studies/Plans



S.B. Van Broekhoven, N. Judson, S.V.T. Nguyen, and W.D. Ross. "Microgrid Study: Energy Security for DoD Installations." Prepared for the Office of the Secretary of Defense under Air Force Contract FA8721-05-C-0002. Massachusetts Institute of Technology Lincoln Laboratories Technical Report 1164. 18 June 2012.

Phase1: JB Pearl-Hickam Circuit Level Demonstration
- Renewables
- Storage
- Energy Management

Phase 2: Fort Carson Microgrid
- Large-Scale Renewables
- Vehicle-to-Grid
- Smart Microgrid
- Critical Assets
- CONUS Homeland Defense Demo
- COOP Exercise

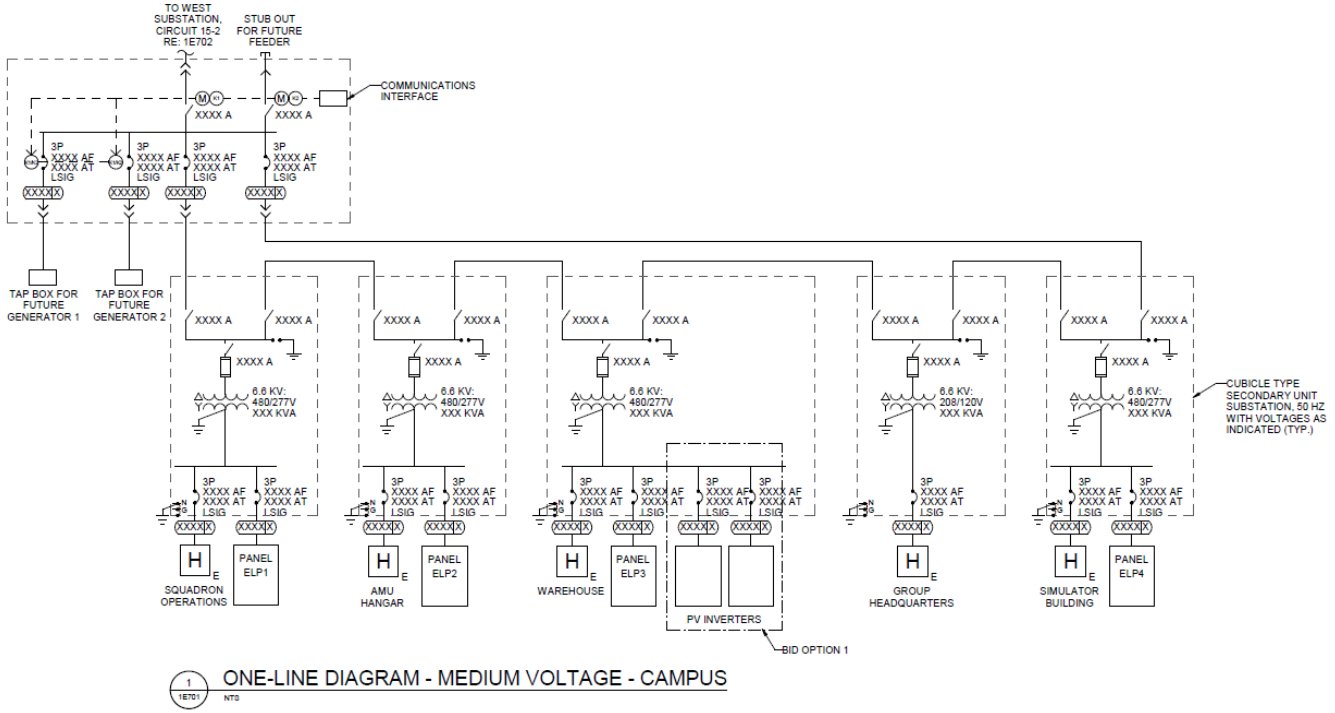
Phase 3: Camp Smith Energy Island
- Entire Installation Smart Microgrid
- Islanded Installation
- High Penetration of Renewables
- Demand Side Management
- Redundant Backup Power
- Makana Pahili Hurricane Exercise

Beyond: Transition
- Template for DoD-wide Implementation
- CONOPS
- TTPs
- Training Plans
- DoD Adds Specs to GSA Schedule
- Transition to Commercial Sector
- Transition Cyber Security to Federal Sector and Utilities

Cyber-Security Solution Development

Hybrid Micro-Grid

- Campus will be grid-connected
- Improve reliability
- Able to “island” if needed
- Accommodates future PV and generator power

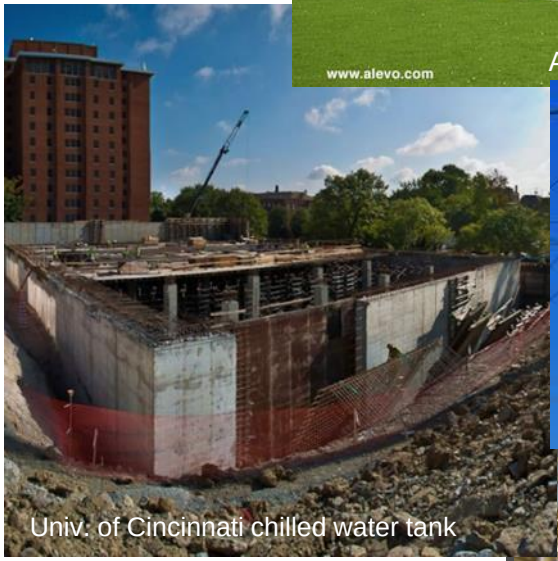


Credit: Jacobs Engineering

3.4 Storage

- Water
  - Tanks
  - Water features
- Energy
  - Batteries
  - Hydrogen
  - Ice/chilled water
  - Geothermal
- Reconsider your planning horizons
  - A 24~48 hour outage might not be long enough

Alevo's GridBank, an "energy reservoir"


Univ. of Cincinnati chilled water tank


Edwards AFB ice storage

Storage

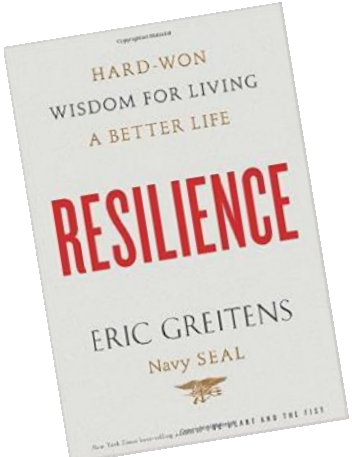
- Why you already used them?
  - Energy and water savings
  - Demand management
- How are they also resilient?
  - Self-sufficiency during outages
- Through a resiliency lenses…
  - Extreme efficiency necessary to make on-site storage and generation sufficient in times of need
  - Redundant & diverse systems might compete with efficiency
  - Favor passive or manual-override systems

3.5 Place-making

- Why you already used them?
  - A nod to “place”
  - Recreate, move and connect with nature
  - Build social cohesion and esprit de cour
- How are they also resilient?
  - Strong communities in which people know, respect, and care for each other fare better during times of stress or disturbance.
  - Natural systems have evolved to achieve resilience - maintain or restore them; use abundant local resources
  - Social equity and community contribute to resilience - can be as important as physical responses

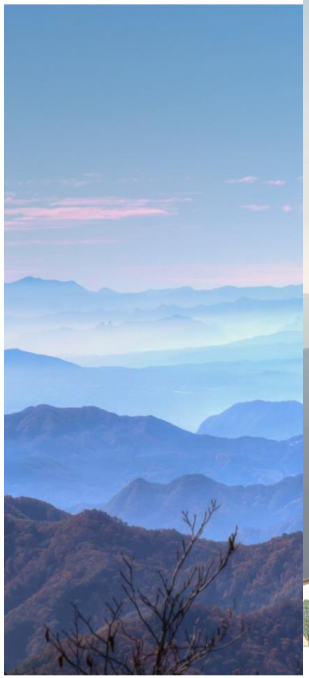
Place-making and Pedestrians

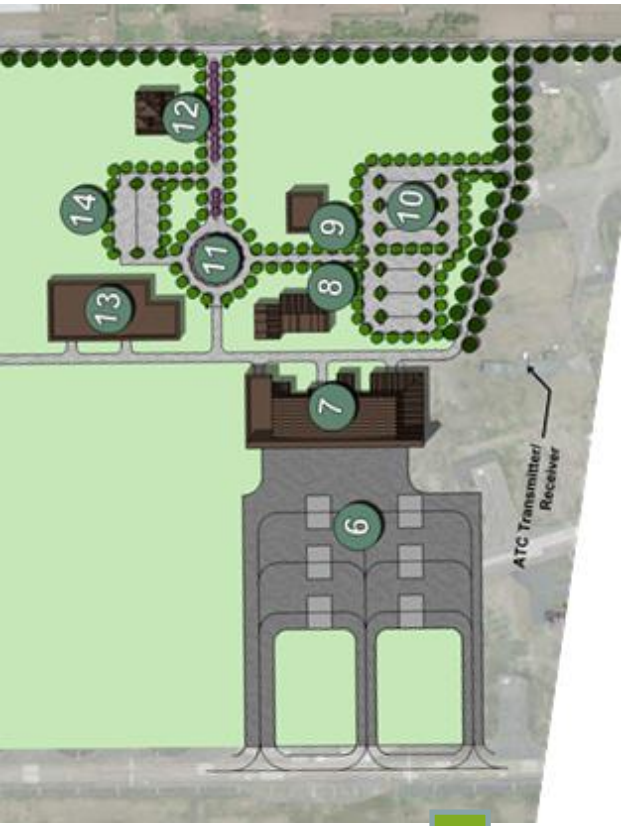
- Resiliency design supports the mission
  - Places of respite
  - Places of gathering
  - Places of ceremony



*"**Resilience** is the virtue that enables people to move through hardship and become better."*

Oku – Layered Planes

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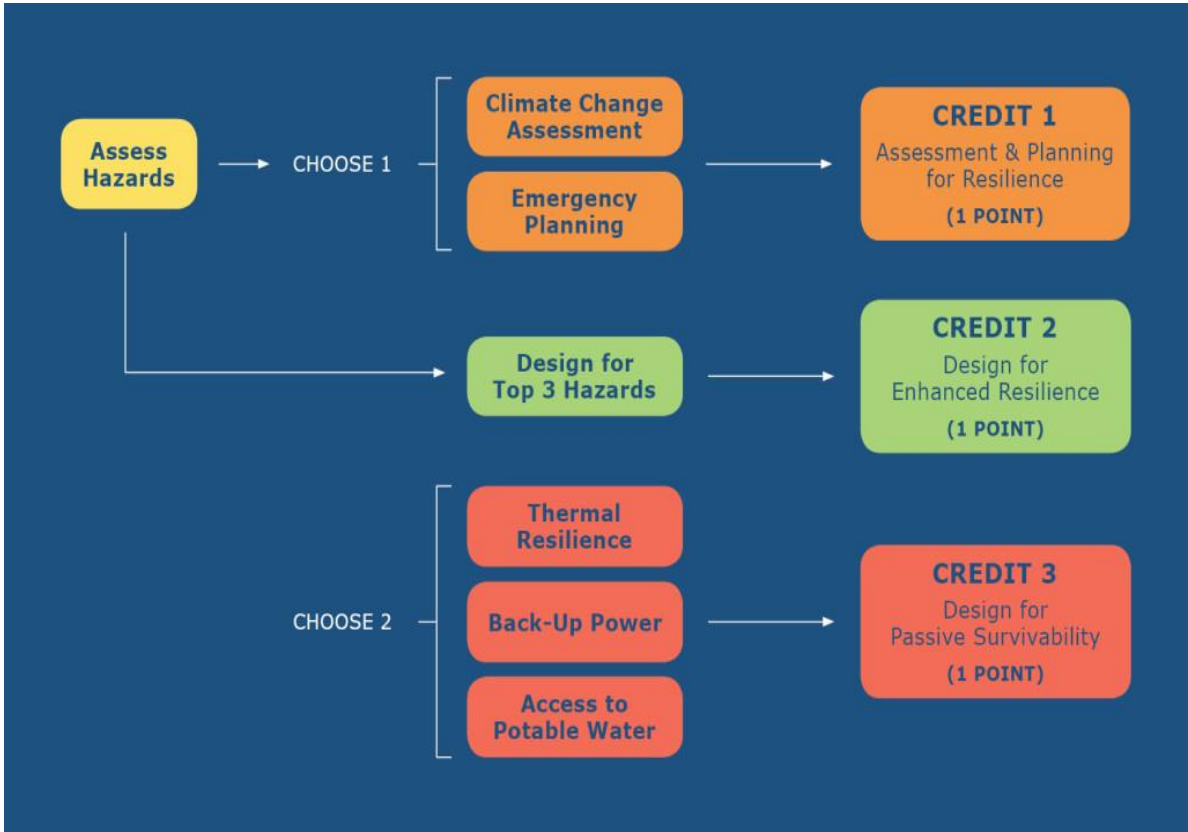
ATC Transmitter/
Receiver


Walker Boulevard
Credit:
Jacobs
Engineering

A resilient campus plan…

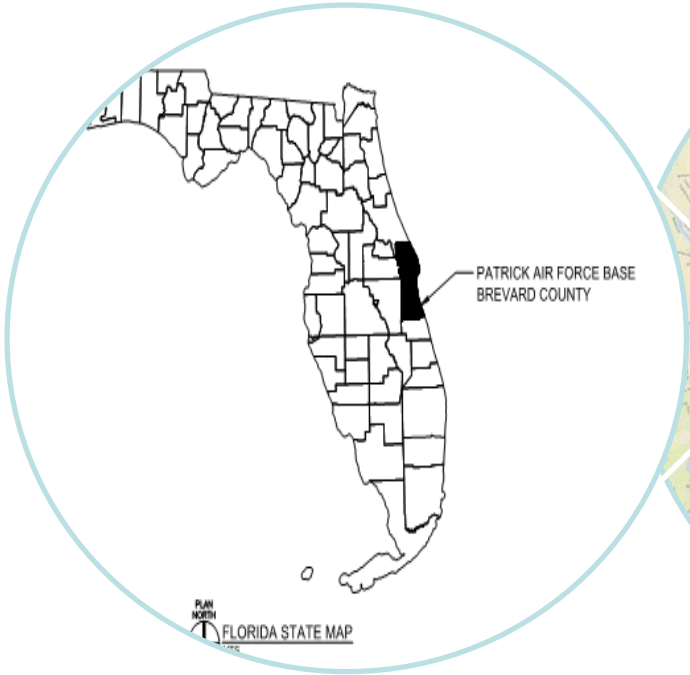
LEED Pilot Resiliency Credits

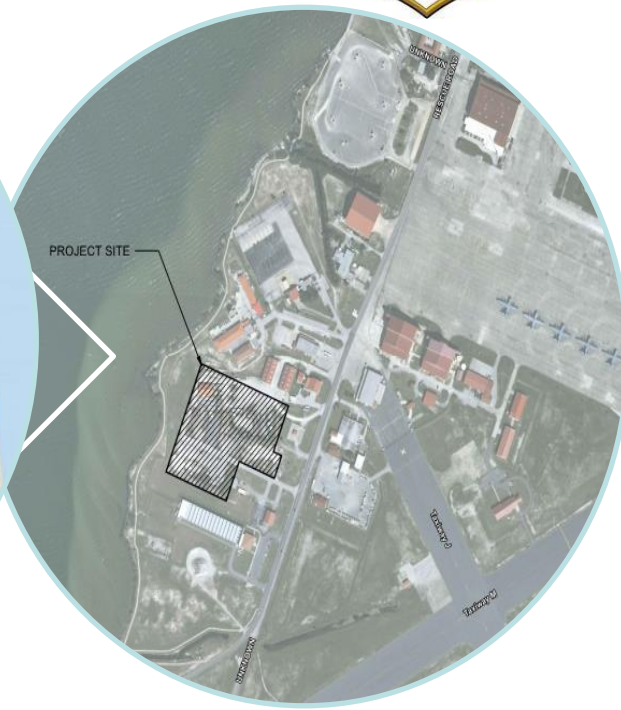
- Assessment and Planning for Resilience (IPpc98)
- Design for Enhanced Resilience (IPpc99)
- Passive Survivability and Functionality During Emergencies (IPpc100)



5 Resiliency for 920th Rescue Wing in Florida

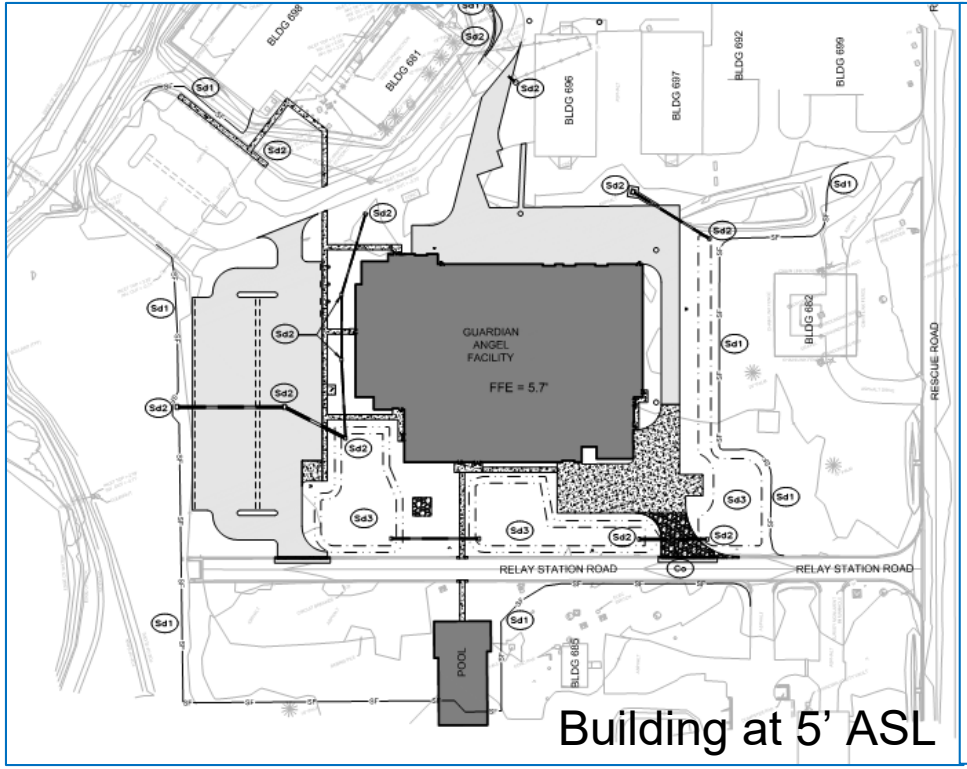
Guardian Angel Facility
Patrick AFB, FL



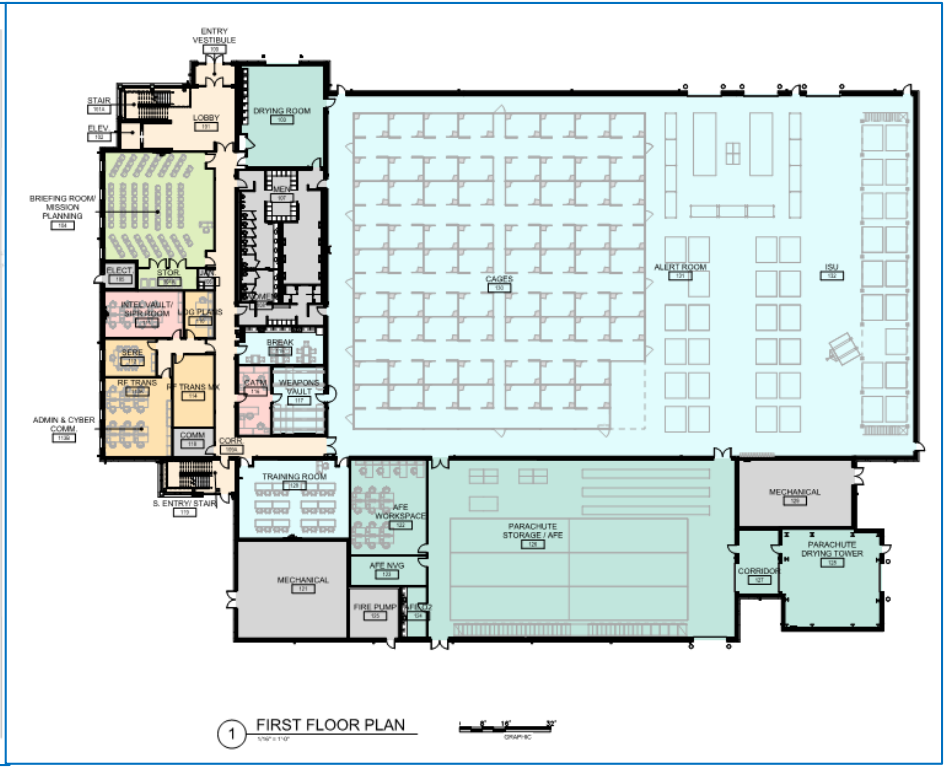


Guardian Angel Facility
Patrick AFB, FL

WOOLPERT RS&H
A JOINT VENTURE



Building at 5' ASL

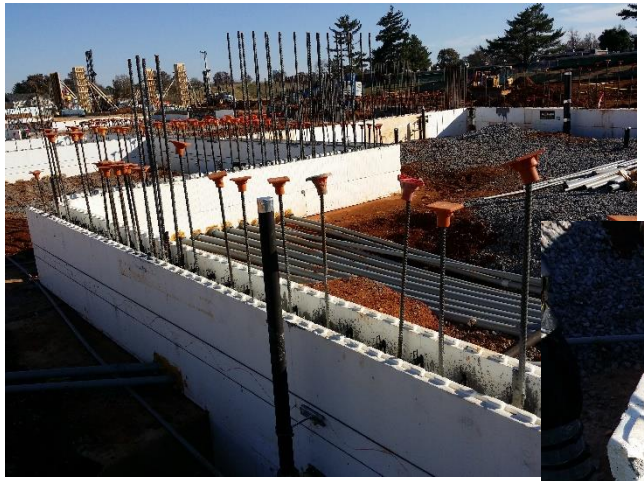


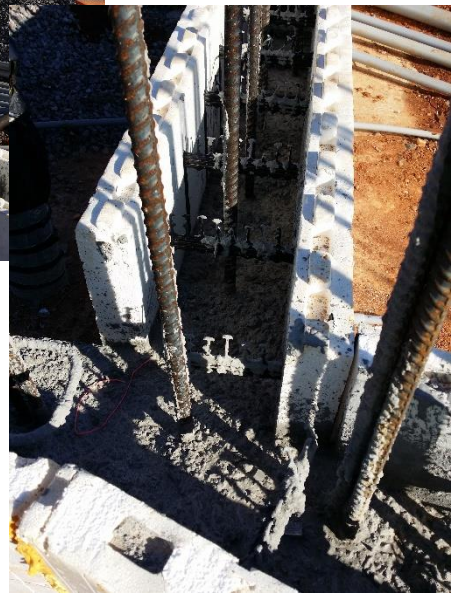
Guardian Angel, Patrick AFB, FL

WOOLPERT RS&H
A JOINT VENTURE

Resilient Design: Dry-proofing

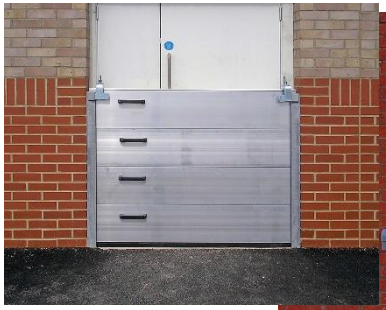
- Membrane vapor barrier adheres to foundation concrete
- ICF building = superior air barrier and insulation
- Miami Dade Hurricane wind/impact requirements met
- Aluminum or stainless steel exterior; textured acrylic finish





Resilient Design: Dry-proofing

- 3’ flood gate system pre-installed at entrances
- All window >3’ up
- All mechanical equipment inside
- 100’ tall parachute drying tower unique
  - Steel frame, 2” insulated metal panel building
  - Could flood; dry-proofing doors into adjoining building



Summary

- Resilient design and resilient facilities
- A few “old” idea with renew purpose
  - HPSB
  - On-site plants & generation
  - Storage
  - Microgrids
  - Place-making
- Resilient design case studies

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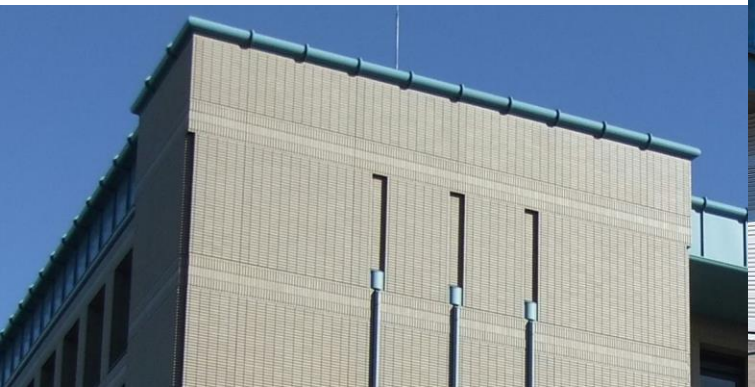
WOOLPERT

Landscape Architecture

- Walkability
- Connectivity
- Public Spaces
- Low Maintenance
- Native Species
- Site Furniture

Architectural – Exterior Building Materials

- Emphasis on locally sourced materials
- Metal panels, exposed concrete, accent tiles
- Roof systems – combination of metal sloped roofs & low slope membrane roofs



AFSOC - Interior Design

Interior Campus Theme

- Unit Recognition
- Who we are – what we do
- Honor past service
- Visual interest – feature wall
- Resilient materials
- Similar “feel” to each building

Air Force Energy Strategic Goals

Goal	Intent	Expected Outcome
1. Improve Resiliency	– Identify vulnerabilities to energy supplies, such as physical and cyber attacks or natural disasters – Mitigate impacts from disruptions in energy supplies to critical assets, installations, and priority missions – Develop ability to prioritize resources against risks to the mission – Advance physical and cyber security solutions to protect critical energy assets and secure industrial controls systems	– Improved responsiveness to disruptions to energy supplies – Increased ability to quickly resume normal operations and mitigate impact to the mission – Prioritized response plans and solutions to mitigate risks from the tail (logistics supply chain) and the tooth (energy demand in operations) – Assured ability to provide energy for mission-critical function
2. Optimize Demand	– Increase energy efficiency and operational efficiency for Air Force systems – Enhance capabilities by focusing on the energy required to achieve the Air Force mission – Build energy considerations into Air Force research, development, test and evaluation (RDT&E) efforts	– Decreased amount of energy required by Air Force systems and operations without negative mission impacts – Increased flexibility, range, and endurance in all operations – Matured long-term, focused solutions to Air Force energy challenges
3. Assure Supply	– Integrate alternative sources of energy compatible with mission requirements – Diversify drop-in sources of energy – Increase access to reliable and uninterrupted energy supplies	– Access to clean energy resources and supply chains based on asset and mission priorities – Increased flexibility in all operations – Increased ability to sustain mission