STANLEYCONSULTANTS

Microgrid Studies Identify Key Design Elements: Joint Base San Antonio Microgrid

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Learning Objectives

1. **Understand Microgrid benefits**
2. **Microgrid planning considerations**
3. **Understand the basics of power system modeling for Microgrids**

Agenda

- **ESPC Background**
- **Distributed Generation Architecture**
- **Critical Mission Load Assessment**
- **Power Modeling**
- **Microgrid Concept Design**
- **Monitored Risks and Recommendations**

Microgrid Benefits

- Leverage the ESPC contract vehicle to provide comprehensive mission support with enhanced resiliency and energy security measures
  - Provide reliable, resilient power to critical facilities and backup power to nearly half of the base loads
  - Distributed Generation assets operating in conjunction with a microgrid for indefinite mission support in the event of a LoU
  - Island from commercial power grid during periods of interruption
  - Increase use of renewable energy (EPACT 05; EISA ‘07) with battery and generation backup capabilities

11.7 MW Southern Landfill Cap Array

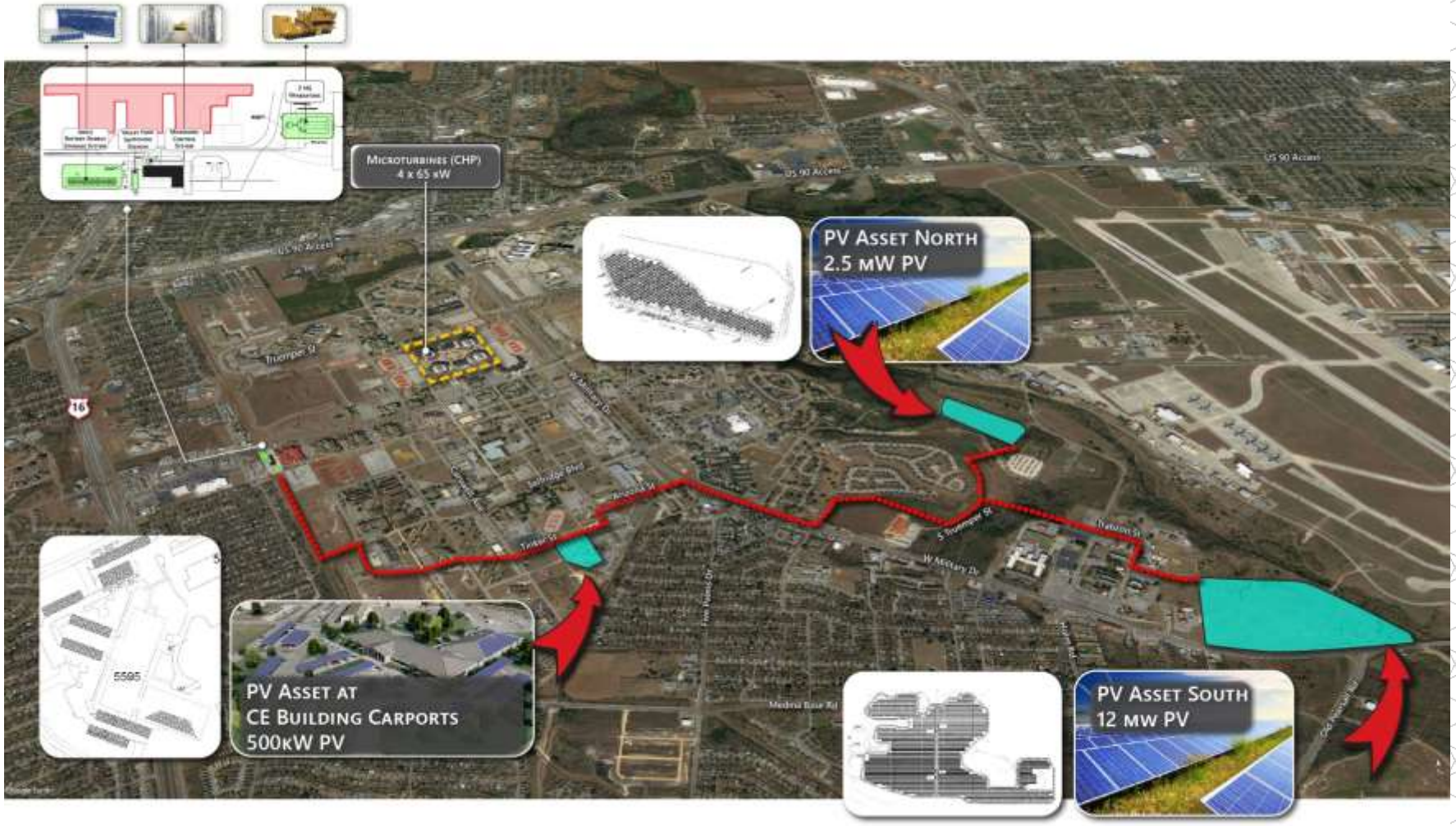
ESPC Background

- Project Development – ECMs:
  - 150,000 new LED luminaries with exterior lighting control and centralized monitoring
  - ~15 MW of Solar PV, landfill, roof-mount and carport
  - Over 2,000,000 gallons of thermal energy storage for load shifting
  - DDC controls upgrades and advanced sequencing in over 285 buildings
  - 4 MW / 8 MWh Battery Energy Storage with 4 MW of gas fired generation for critical load support
  - 585 kW of Combined Heat and Power (CHP) at Critical Loads
- Environmental Assessment:
  - AF 813/814 and NEPA/EA Process underway with support from AFCEC and CE
- Timeline & Way Ahead
  - Desing/Build Award Summer 2018, Completion Summer 2020

Distributed Generation Architecture

- A dedicated network facilities seamless transition to critical facility loads during a LoU via a dedicated controls network
- Solar PV Array
  - 11.7MW South Landfill
  - 2.59MW North Landfill
  - 474kW CE Building Carport
- Battery Energy Storage (BESS)
  - 4MW-8MWH Lithium Ion
- Stand-by Generators
  - (2) 2MW Gas reciprocating engine generators
- Resulting in fully resilient and seamless transition during a critical event – **that can maintain operation of critical load indefinitely**

Distributed Generation Architecture

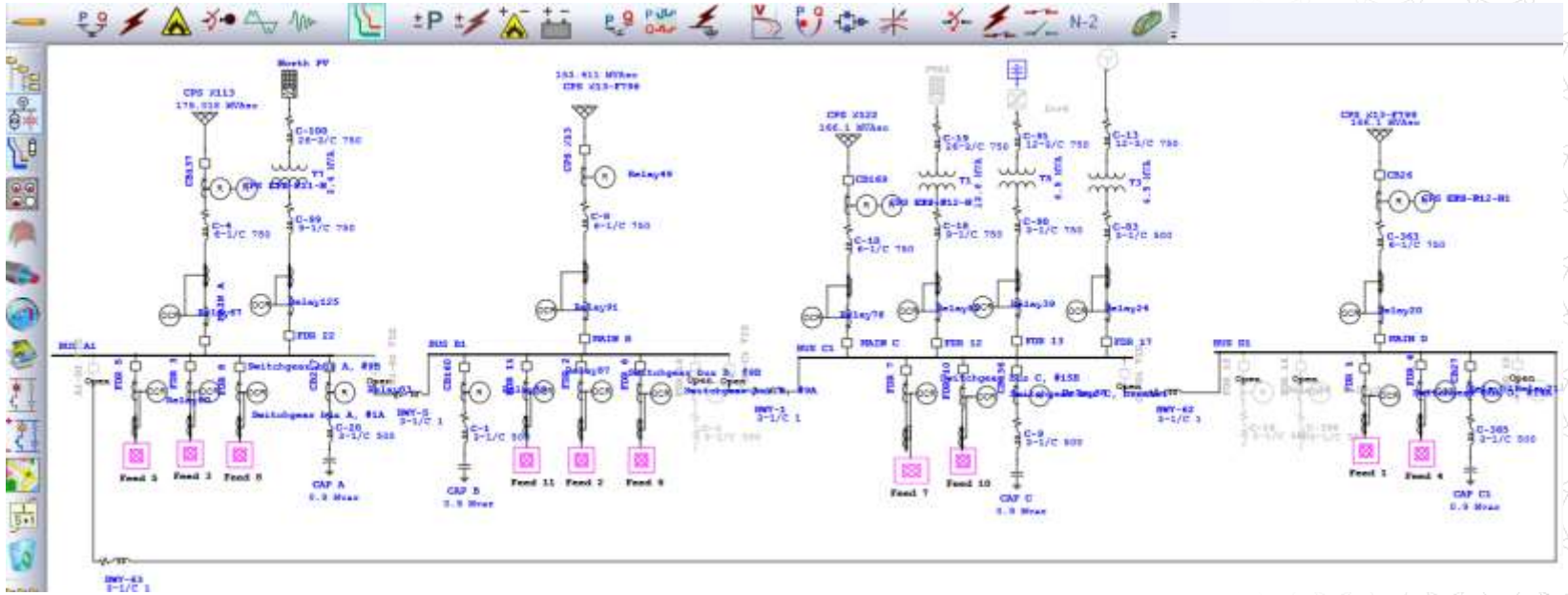


Critical Mission Load Assessment

- Interviews with JBSA Leadership
- CEMP 10-2 Facility Priority List
  - Basic Military Training Campus – Airmen Training Complexes (ATC)
  - 25th AF (Intel)
  - 24th AF (Cyber)
  - 502nd Communications Squadron
  - 37th TRW (Training Wing)
  - San Antonio Military Medical Center (SAMMC)
  - Fire Station / Emergency Operations Center

Power Modeling

- Electrical Model – Setup:
  - Collect existing data – Single-Lines, Equipment cut sheets, O&Ms,
  - Distribution Model in ETAP
  - Field validation (Survey) and equipment assessment



Power Analysis

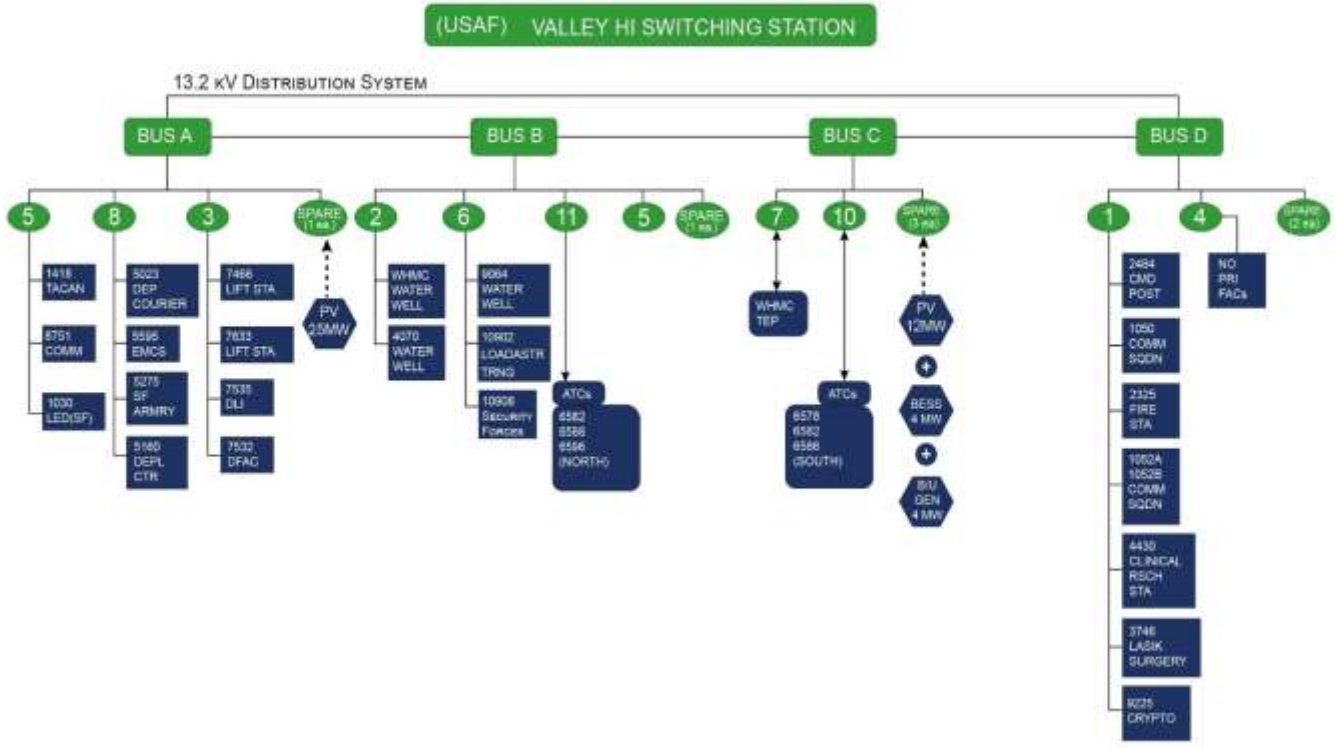
- Load Flow Study:
  - Current configuration - validated cable sizing, breaker sizing, switchgear ratings
  - Proposed configuration – validated DG insertion points capable of accommodating new equipment (Normal, Islanding)
- Short Circuit Analysis:
  - Current & proposed configurations – evaluated short circuit ratings of equipment
- Coordination Study:
  - Current configuration – validation of protection scheme
  - Current Issues – 15 mis-coordinated fuses, for immediate corrective action

Power Analysis

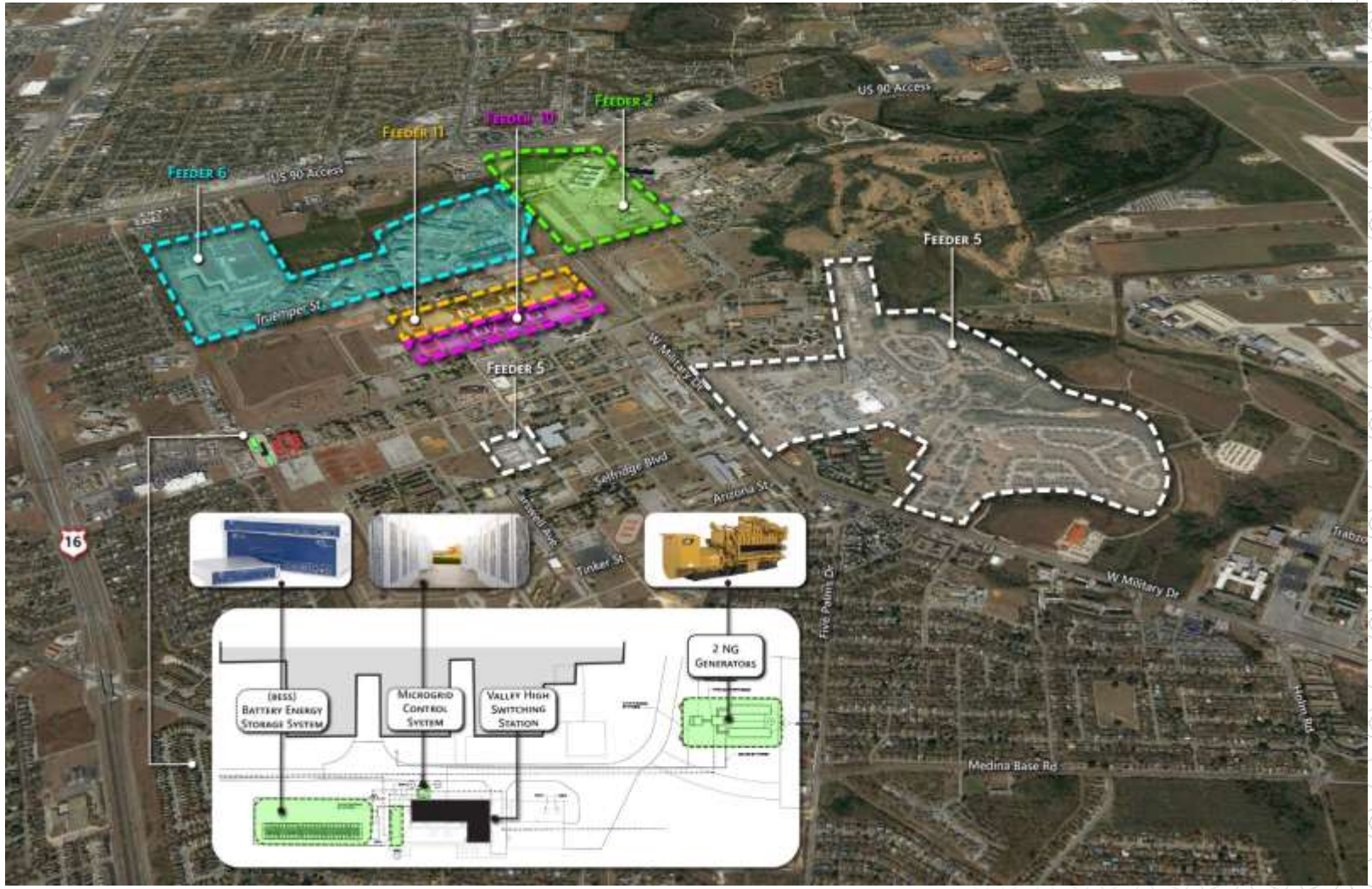
- Reliability Analysis:
  - Reviewed circuit configurations, proposed equipment
  - Redundancy, loop fed, review of outage history
- Transient Analysis:
  - Evaluated DG interaction/behavior with MV system
  - Islanding & fast load shed sequencing
  - Key outcome – development of criteria for inverters of BESS & PV
  - BESS and NG Generation are essential for stability

Microgrid Concept Design

- Conceptual Design considers:
  - Load locations
  - Optimization (generation-to-load)
  - Ties
  - Switching
  - Re-wiring requirements
  - Load shed priorities
  - Expansion / Scalability consideration



Microgrid Coverage



Concept of Operations

- Normal Mode
  - MCS to monitor loads
  - DG to reduce peak loads
  - Future: Demand Response from Utility (Natural Gas Generators)
- Islanding Mode
  - MCS to determine Loss of Utility and takes system control and fast load shed
  - BESS to provide ride through power – No blackstart
  - BESS to provide stability and frequency control
  - PV to provide power during peak periods
  - Natural Gas Generators to provide baseload capacity and additional stability
  - MCS to monitor loads and additional load shed to match load to generation

Lessons Learned – Monitored Risks

- Jurisdictional Provider Concerns – CPS Energy
- Grid Interconnect – CPS Application
- NEPA – Environmental Assessment
- Utilities Privatization
- Master Plan (need for)

Summary

- Energy resiliency microgrids can be delivered through 3rd party financed projects
- State of the art technologies (MCS, PV, BESS, Microturbines) are driving down costs and increasing performance
- On-base, distributed generation can be incrementally matched to critical facility loads and island from the grid during outages
- DG peak shaving capability can save significant utility dollars
- Up-front planning will optimize execution costs and performance
- DoD, USAF energy resiliency project scoring may provide more resources
- ***Microgrids = Resiliency = Mission Assurance!***

Questions