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Venetie, AK Microgrid Assessment and Recommendations

Richard Jensen, Jim Brainard, Mike Baca and Ben Schenkman

U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration

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Objective

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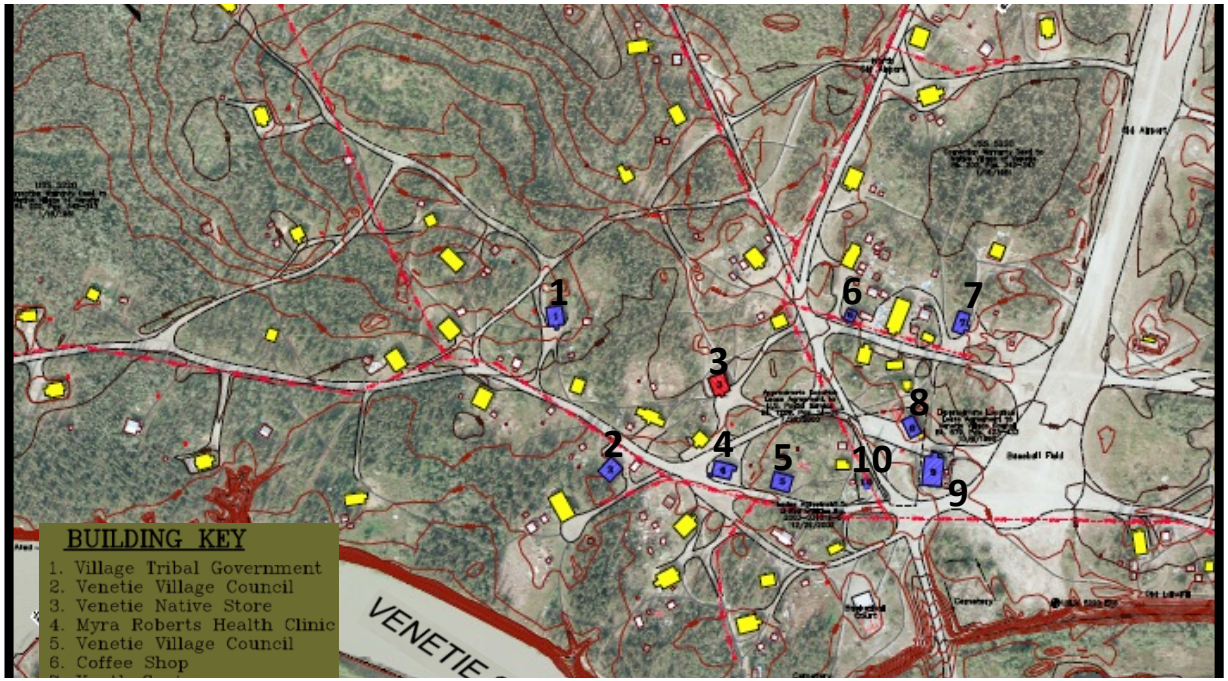
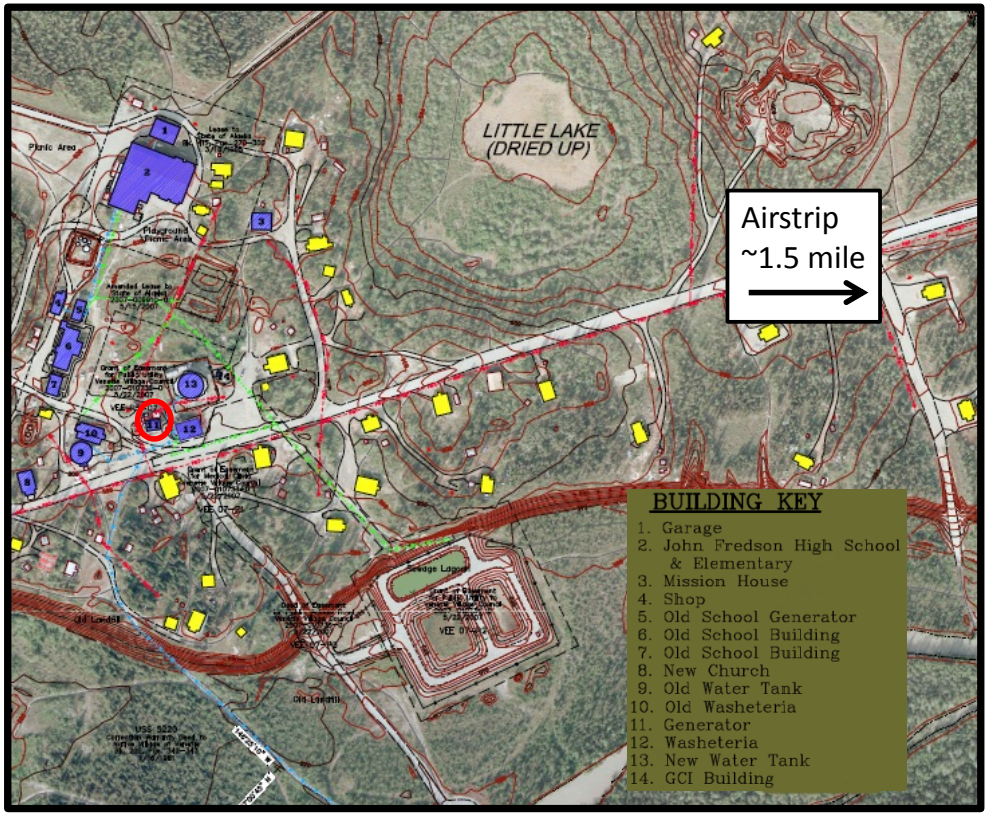
- Provide technical assistance to the DOE Office of Indian Energy
  - Assist in assessing current electrical systems in Venetie, Alaska
  - Perform preliminary design for upgrading existing electrical power system
- Preliminary design
  - Electric system characterization
    - Existing principal generation resources
    - Existing distribution system
    - Existing available renewable energy resources
  - Perform consequence model
  - First order load-flow model
  - Performance reliability model
  - Recommendations and requirements for the microgrid that would bound the more detailed engineering design, including cost estimate

Venetie, Alaska



North Venetie with key buildings

Venetie, Alaska



South Venetie with key buildings (generator building in **red circle**)

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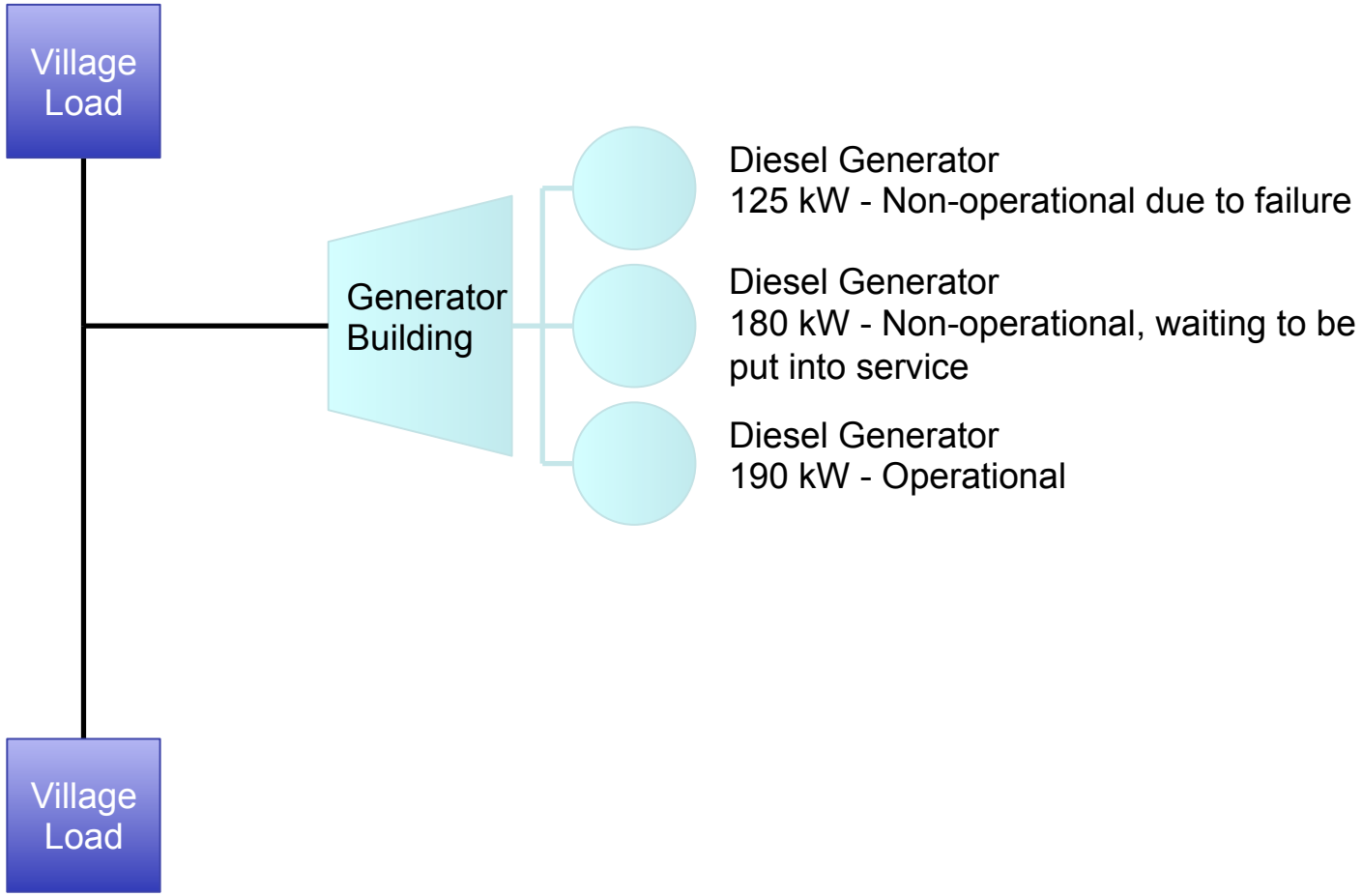
Venetie Generator building with 1500 gallon fuel tank in foreground

Existing Electrical Grid



Venetie Microgrid Design

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- Role of Consequence Modeling
  - Evaluate potential design scenarios
    - investigate the impact of current and potential generator combinations given daily and seasonal load uncertainty
      - visualization of load profiles aids in identification of strengths and weakness of each design
      - power production histograms give a measure of efficiency of potential generator stacks
      - fuel consumption calculations approximate fuel savings for employment generators sized to meet the load

Venetie Microgrid Design

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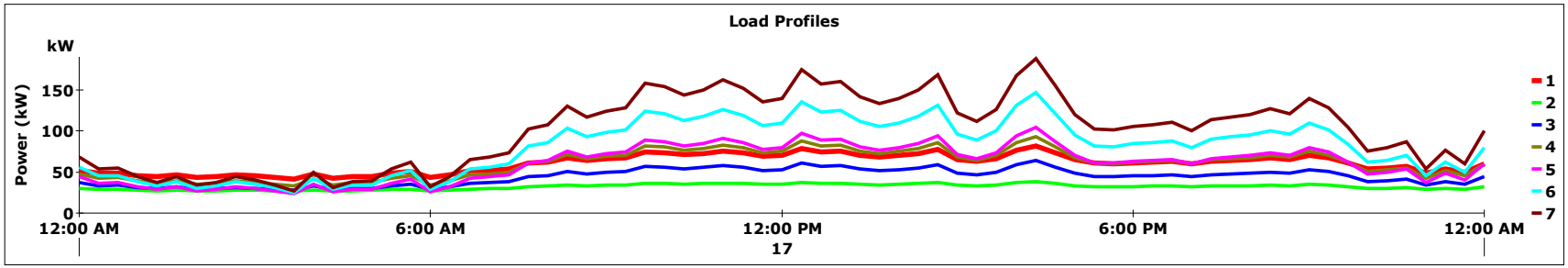
- Loads and current generators
  - Peak load in Feb approximately 150 kw
  - Peak Load in April approximately 80 kw
  - Low loads approximately 20 to 40 kW
  - One 190 (kW) generator
  - One 180 (kW) backup generator not currently operational
- Generators are likely under utilized
  - increased maintenance from wet stacking
  - increased fuel costs due to lower gal/kwh at low power production

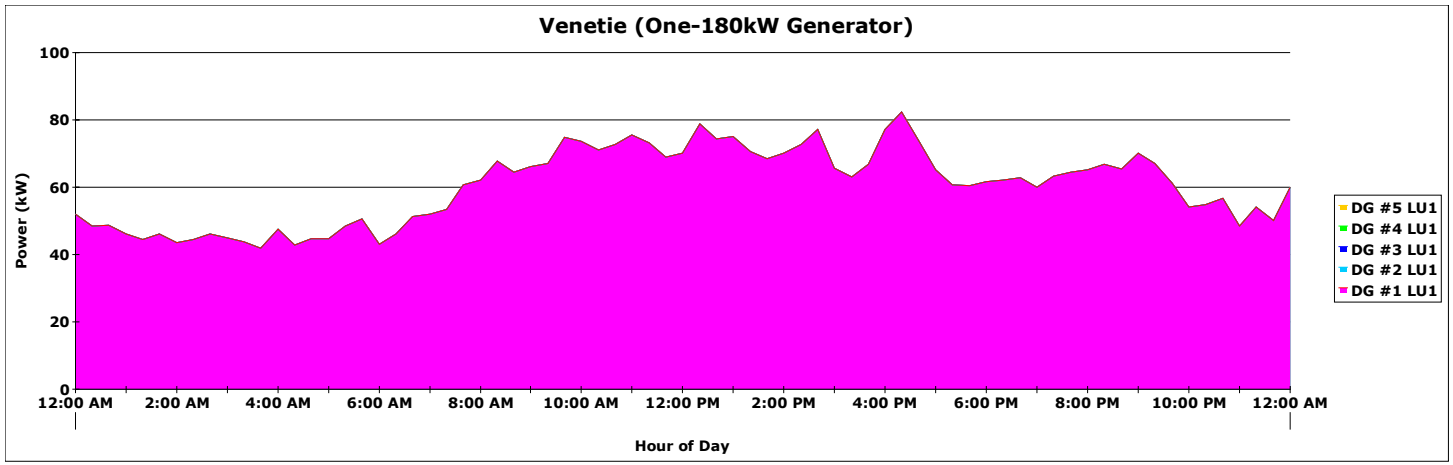
Venetie Microgrid Design

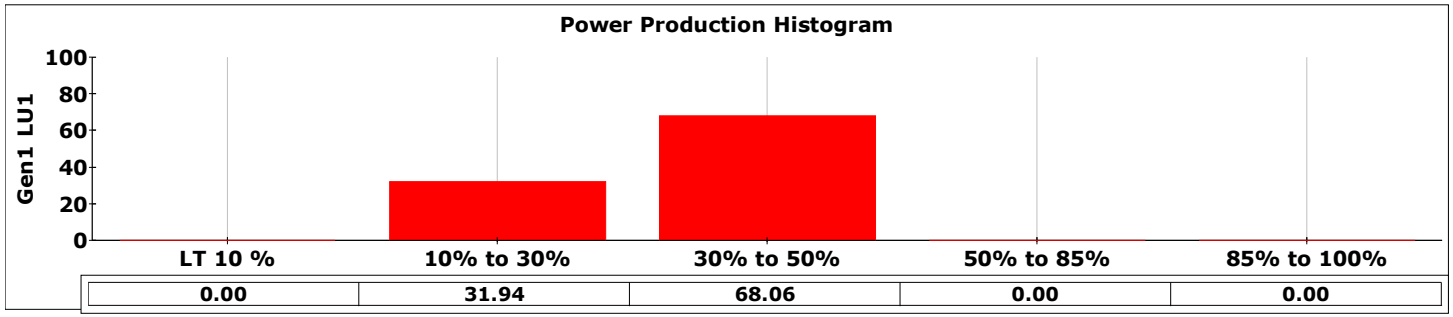
- Load is approximated to peak at 150 kW during the winter and 60 kW during the summer
- Surrogate load profiles are used to approximate load
  - Remoteness of the village and the associated expense of obtaining this data precludes working with actual load data
  - surrogate load profiles are from similar sized villages in AK and are scaled to approximate higher and lower loads for modeling puposes
  - the surrogate load profile is typical of a community where daytime work and school activities result in a mid day peak followed by a second evening peak from home use of energy



Venetie – Current Design

- Load profile and generator power production:
  - note that the generator always runs less than 50% of capacity





Venetie – Potential Design

- Load profile and generator power production:
  - Two 50 kW generators