Kokhanok Wind-Diesel System Update

John Lyons
Marsh Creek Energy Systems
AK Native Village Energy Development Workshop
April 29, 2014
## Kokhanok Electric Utility

| System | 470 kW of diesel power  
<table>
<thead>
<tr>
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<th>2 refurbished Vestas wind turbines rated at 90 kW each</th>
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</thead>
<tbody>
<tr>
<td>Power Generation</td>
<td>459,251 kWh in 2013 (17% wind – down from 30% 2012)</td>
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<tr>
<td>Peak Demand</td>
<td>106 kW</td>
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<tr>
<td>Population Served</td>
<td>170</td>
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System Overview

KOKHANOK
HIGH PENETRATION NO-STORAGE WIND-DIESEL SYSTEM
USING SYNCHRONOUS CONDENSER
AND SECONDARY LOAD

SYSTEM OVERVIEW

ELECTRIC BOILER
THERMAL NODE #3
SCHOOL OR COMMUNITY
BUILDING

125KVA
THERMAL ELECTRIC
WITH STORAGE

INTERFACE
SME

TO STATION
MASTER SYSTEM

200 KVA
2.5 KV RIDE THROUGH

PT/CT

480V/12470 GRD "y" 3 PH TRANSFORMER "STEP-UP"

TRANSFORMER
112.5 KV
480V/12470
WYE/WYE
PAD MOUNTED

#2 ACSR 15K (TYPICAL)

VILLAGE LOAD (TYPICAL)

APPROX
BURIED #2 COPPER

15KV SWITCHGEAR
CABINET - CONNECT TO OVERHEAD T & D

VILLAGE LOAD

KOKHANOK
HYBRID WIND
SYSTEM

MARSHCREEK
ENERGY SYSTEMS
A Division of Marsh Creek, LLC
System Overview

- Grid forming inverter
- 336 kWh nominal battery storage
- Synchronous condenser
- Thermal electric heat recovery system and secondary load control
- Two (2) Vestas V-17 turbines 90 kW each
- Four (4) Diesel Gen-sets
  - #1 - 65 kW
  - #2- 115 kW
  - #3 – 160 kW
  - #4 – 160 kW
Production Data – Turbine #1

Kokhanok 1 Performance

Data: 11/23/12 to 1/29/13

Source: Douglas Vaught, P.E. - V3 Energy, LLC
Production Data – Turbine #2

Source: Douglas Vaught, P.E. - V3 Energy, LLC
Where are we?

- **2014 Wind Turbine Generator Production**
  - WTG 1: 0 kWhs  
  - WTG 2: 0 kWhs

- **Annual Wind Farm Energy Production**
  - 2011: 66,449 kWhs  
  - 2012: 150,396 kWhs  
  - 2013: 78,854 kWhs

- **School Heating Fuel Use Comparisons for Pre-Wind vs. Post Wind**
  - 2010: 6,577 gallons  
  - 2012: 6,595 gallons
  - 2011: 5,451 gallons  
  - 2013: 3,784 gallons

- **System Efficiency (kWhs produced per gallon of diesel burned)**
  - January 2010: 12.4 kWh/gallon  
    - 3,845 gallons to produce 47,734 kWhs
  - January 2013: 18.6 kWh/gallon  
    - 3,017 gallons to produce 56,006 kWhs
  - January 2014: 11.33 kWh/gallon  
    - 3,532 gallons to produce 40,019 kWhs
Path Forward

- O&M Phase with the community – year 4 of 6 year agreement
  - Highly skilled local diesel technician now on board who is willing to climb and do WTG maintenance.
- Wind Farm curtailed since October and shut down since January due to lube oil contamination in coolant loop at the diesel plant.
  - Wind-Diesel Tech from Marsh Creek scheduled for site visit to put wind turbines back on line – as soon as the local diesel tech gets certified to safely climb the tower. Next class scheduled for the last week of May.
- Additional O&M Costs in 2013 requires a customer rate increase. The utility is awaiting a new PCE rate, based on 2013 costs, to implement.
- Final phase of high penetration system, the battery inverter, will be installed summer 2014. At that point the system will be able to run “diesels off” - with a trained local wind-diesel tech to watch over it.
Questions?

John Lyons
john.lyons@marshcreekllc.com