Kongiganak Wind Turbine Replacement and System Upgrade Project

Recipient Organization:	**Native Village of Kongiganak**
Award Number:	**DE-EE00006481**
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EXECUTIVE SUMMARY

The Native Village of Kongiganak, Alaska was awarded a grant to upgrade the braking systems on five wind turbines and upgrade the monitoring and data collection unit to insure that enough energy is available to power the utility. The project manager for this award is Intelligent Energy Systems, LLC located in Anchorage, Alaska. In addition to accomplishing these upgrades, it was the intent for a local wind tech crew to be trained in Kongiganak so that routine maintenance and future repairs will be made by local workers.

PROJECT OVERVIEW

The Native Village of Kongiganak, governed by the Kongiganak Traditional Council and its electric utility, Puvurnaq Power Company operate a cutting edge hybrid wind-diesel power plant. Five 95 kilowatt refurbished Windmatic turbines add renewable power to their diesel grid.

During a powerful wind storm, one of the five wind turbines experienced a catastrophic incident when a brake failure occurred. After the brakes failed to secure the rotor, the nacelle broke free from the tower, fell to the ground and is beyond repair.

The project included replacing the lost nacelle as well as upgrading the braking systems on all five wind turbines. The wind turbines had proven operational capacity in Kongiganak but had never been installed in a location with such intense weather regimes. Upgrading the braking systems allowed for additional safeguards against total turbine loss. The production from all five wind turbines is needed to provide enough excess wind power for the currently installed and newly funded additional residential heating stoves. These stoves have saved, on average, 260 gallons of heating oil annually in homes where installed.

BACKGROUND

The Native Village of Kongiganak is a member of the Chaninik Wind Group a four village consortium working on developing solutions for harnessing their local wind energy, building benefits of shared administrative capacity. The four villages (Kongiganak, Kwigillingok, Tuntutuliak and Kipnuk) are in close proximity to each in the lower Kuskokwim area. Over the

last eight years, Kongiganak has worked to develop community scale wind based power systems. This development required specialized technologies that at low wind speeds results in a high contribution of wind energy displacement of diesel electric generation, while at modest and high wind speeds, generated surplus energy is captured and stored in electric thermal storage devices to heat homes. These systems are changing the economics of wind systems for villages because they are proving to displace large amounts of fuel at the utility and the surplus wind energy is sold for $.10/kilowatt/hour which equates to $2.59/gallon diesel---much less expensive than the current $6.96/gallon price for heating fuel at the store. This achieves the objectives of reducing dependency on diesel fuel, lowering energy costs to consumers and increasing revenues to the local utility.

There are twenty electric thermal stoves installed now. With the excess wind energy from five wind turbines, there is enough capacity to install approximately fifty stoves in total. The Alaska Energy Authority recently recommended funding through the Renewable Energy Fund Round 7 for an additional thirty stoves.

OBJECTIVES

The objectives of this project are to replace a single wind turbine nacelle, upgrade the braking systems on five wind turbines and upgrade the monitoring and data collection unit at the powerhouse to ensure that enough energy is available to power the utility and twenty residential heating units. In addition, it was the intent of this project to provide training to the local wind tech crew in Kongiganak so that these systems may be maintained.

DESCRIPTION OF ACTIVITIES PERFORMED

- Planning and design for the brake system upgrades
- The brake systems on all turbines were replaced with improved braking components.
- Turbine 5 was outfitted with a new brake fluid level sensor and brake pressure gauges were installed.
- Procurement of the nacelle, blades and up-tower control components was accomplished. The nacelle was inspected prior to shipping. The blades were painted and secured for shipping.
- Transportation arrangements of the above items to Seattle, Washington to coincide with the summer barge to Kongiganak, Alaska were made.
- The barge delivered the nacelle, blades and components to Kongiganak.
- Assisted wind techs in modifying and upgrading System Control and Data Acquisition, SCADA.

- Crane delivery to Kongiganak was completed.
- Crane boom and manbasket were delivered to Bethel.
- Crane boom was transported from Bethel to Kongiganak using the CWG Snocat and sled. Frozen river conditions deteriorated making land transportation impassable. Helicopter services were required to finish moving the crane boom to site.
- Turbine tower was prepared for nacelle installation.
- Turbine nacelle was installed on the tower.
- Turbine commissioning was completed.

PROBLEMS NOT ANTICIPATED

In April 2016 a boom for a crane was needed to complete the project. The boom was transported to Bethel, Alaska. By the time the boom arrived, there were no more small barges with landing craft available to transport it from Bethel to Kongiganak, Alaska which is located on the west shore of the Kuskokwim Bay, seventy miles southwest of Bethel. The boom is a bulky, light item that will not fit in a small aircraft so it was decided to transport it using a snowcat and sled belonging to the Chaninik Wind Group. The decision to use the snowcat was not unusual. The snowcat had been previously used for this kind of transportation many times (up to twenty) in the past. Using the snowcat had the added advantage of utilizing local labor and equipment. Snowcat transportation has been utilized in the past up until May 1 prior to spring breakup.

Unfortunately, in 2016 because of an extraordinarily early spring probably due to climate change, we found ourselves caught in a climatic melt (see attached articles) and the snowcat became stuck in late March near the community of Tuntutuliak, Alaska. In order the deal with transporting the boom the rest of the way to Kongiganak, we were forced to charter a helicopter. Dealing with the snowcat stuck in the melting ice required utilizing labor in the villages of Tuntutuliak and Kongiganak and Intelligent Energy Systems, LLC. This resulted in a total of $33000.00 in increased expenses.

LESSONS LEARNED

Unforeseen problems in this project were a reaffirmation of the changing environmental conditions and the need for contingency plans. The remoteness of these Alaskan villages with no road access and unpredictable freeze/thaw conditions requires careful planning. Moving equipment, parts and manpower requires coordination with barges and aircraft. The barges are

limited by the open water. The type of aircraft able to fly into these villages is limited by the airstrips, weather conditions and aircraft available in the small town of Bethel, Alaska.

CONCLUSIONS AND RECOMMENDATIONS

Overall, we consider this to be a very successful project. The technical goals stated in the Objectives section of this report were accomplished. But, more importantly the local wind crew techs were trained to provide repairs, regular maintenance and to source parts needed for repairs and maintenance. There were three wind techs that were trained and actually accomplished the tasks of this project. These wind techs are long-term residents of Kongiganak and intend on staying in their community. Because of the close proximity of the other three villages of Kwigillingok, Tuntutuliak and Kipnuk they will be able to help out in those communities. These local crews are adept and talented and were able to complete the project.

APPENDIX

Photo log

Crane boom transportation from Bethel to Kongiganak overland and by air due to early break up conditions on the Kuskokwim River

Sno-Cat and helicopter pictured transporting the crane boom to Kongiganak

Tower repaired and being lifted into position

Nacelle being lifted into position

Turbine installed PPC Windtechs pictured

Crane stored onsite for the season. Note thawed ground

Kongiganak Power Plant Energy Summary 2016

KONGIGANAK POWER PLANT

2016 Energy Summary (kWh)

Generation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Diesel 1	4,930	4,700	9,700	2,230	21,480	39,200	410	1,260	1,120	1,240	1,320	-	**87,590**
Diesel 2	-	-	-	-	-	20	20	-	-	-	-	-	**40**
Diesel 3	61,580	66,040	52,580	72,140	52,700	33,300	68,980	83,140	70,810	61,460	72,120	-	**694,850**
Diesel 4	-	-	-	-	-	70	-	-	-	-	140	-	**210**
Total Diesel Generation	66,510	70,740	62,280	74,370	74,180	72,590	69,410	84,400	71,930	62,700	73,580	-	**782,690**
Wind Turbine 1	24,126	13,123	18,804	7,613	12,304	7,248	6,110	5,358	7,706	13,758	10,852	-	**127,002**
Wind Turbine 2	14,442	3,336	12,733	7,478	-63	-59	3,201	2,815	7,446	14,156	12,097	-	**77,584**
Wind Turbine 3	-64	13,731	22,342	9,350	16,464	9,238	7,615	4,470	6,966	18,117	17,345	-	**125,574**
Wind Turbine 4	-63	-59	-63	5	1,084	-58	608	1,173	7,863	15,564	13,870	-	**39,925**
Wind Turbine 5	26,112	18,193	22,688	8,938	10,642	5,495	4,191	5,288	7,734	13,810	11,007	-	**134,098**
Total Wind Generation	64,553	48,324	76,503	33,384	40,431	21,865	21,727	19,105	37,715	75,404	65,171	-	**504,183**
Total Generation	**131,063**	**119,064**	**138,783**	**107,754**	**114,611**	**94,455**	**91,137**	**103,505**	**109,645**	**138,104**	**138,751**	**-**	**1,286,873**

Consumption	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Station Service	2,648	2,551	2,503	2,903	2,830	2,578	3,252	3,418	3,123	2,901	2,773	-	**31,480**
Wind to Village	44,798	33,831	46,621	22,145	27,389	17,155	17,420	13,260	24,682	45,840	37,721	-	**330,861**
Wind to Load Regulator	8,705	6,465	12,263	5,664	8,236	4,710	4,307	5,068	7,944	18,820	12,923	-	**95,106**
Wind to ETS	11,050	8,028	17,619	5,576	4,806	0	0	777	5,089	10,744	14,527	-	**78,217**
Total Village	111,308	104,571	108,901	96,515	101,569	89,745	86,830	97,660	96,612	108,540	111,301	-	**1,113,551**
Total Consumption	**131,063**	**119,064**	**138,783**	**107,754**	**114,611**	**94,455**	**91,137**	**103,505**	**109,645**	**138,104**	**138,751**	**-**	**1,286,873**

% Diesel kWh Displaced by Wind	**40.2%**	**32.4%**	**42.8%**	**22.9%**	**27.0%**	**19.1%**	**20.1%**	**13.6%**	**25.5%**	**42.2%**	**33.9%**	**-**	**29.7%**