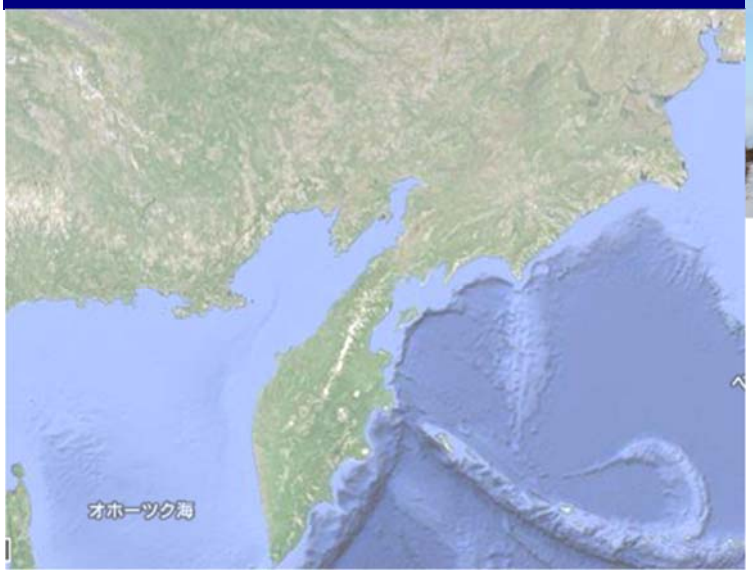
Wind Turbine in Cold and Isolated grid areas with Micro-grid system



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Project Background

<Issues>
- Hundreds of remote communities in Far East not connected to regional or main electric grid system.
- Dependence on Diesel generated electricity.
- Diesel generated electricity is Expensive and Environmentally Unfriendly.
- Diesel fuel delivery tends to be interrupted by winter storm.

<Proposed Solution>
- Many of isolated grid areas are Rich in Wind Resource.
- Wind energy generation cost can be Cheaper than diesel generation.
- Medium size wind turbines (around 300kW) is suitable considering the electricity and construction infrastructure of the remote area.
- Cold climate model is developed to cope with the sever climate.
- Impact of wind energy fluctuation is mitigated with micro grid system

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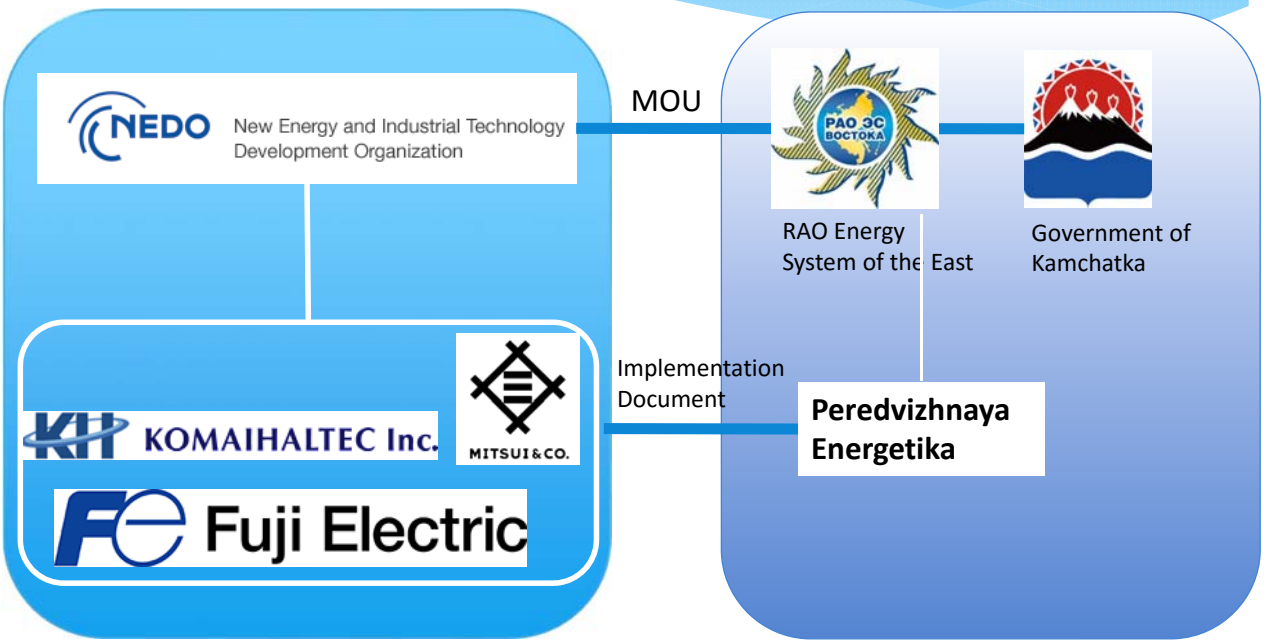
Project Framework: Demonstration Project of Cold Climate 300kW wind turbines and output stabilization system in Ust-Kamchatka, Russia



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Ust-Kamchatsk cold-climate resistant wind generation and micro-grid pilot project

Project Overview

- Project Size: 300kW x 3 units, 3 types of cold climate model and grid stabilization system
- Finance: NEDO
- Executing Agency: NEDO, Kamchatka Krai government, RAO ESE
- Contractor: MITSUI & CO.
  Fuji Electric Co., Ltd.
  KOMAIHALTEC Inc.
- Scope of contract: Design, Supply and Installation and 10 month demonstration and evaluation of the system.

Project Schedule

- MOU signed: Oct. 2014
- First wind turbine installation: Dec. 2014
- 3 wind turbines and stabilization systems start operation: Nov. 2015

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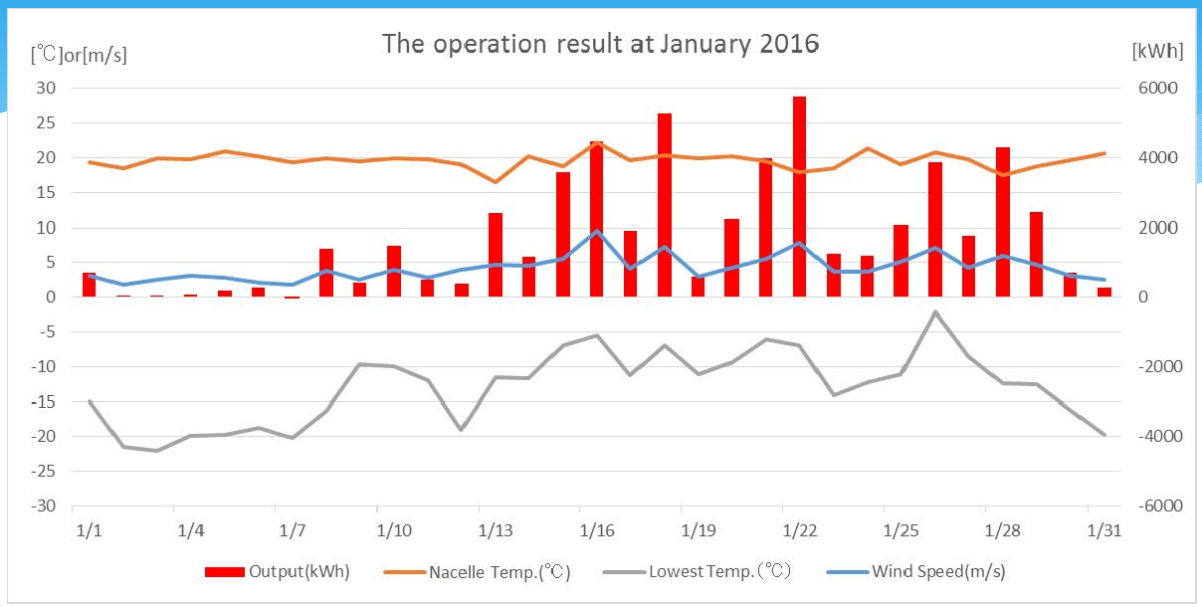
Wind turbine operation results in Ust-Kamchatk



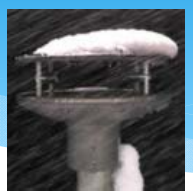
* Wind turbines keep operation under -20℃
* Temperature inside the nacelle keeps at constant temperature

Representative technical elements for safety operation in cold climates

①Special paint preventing the icing on wind turbine blades

-The paint chosen from 4 kinds of special paint in the fleezing test plant

-No Icing of blades in the Ust-Kamchatk site

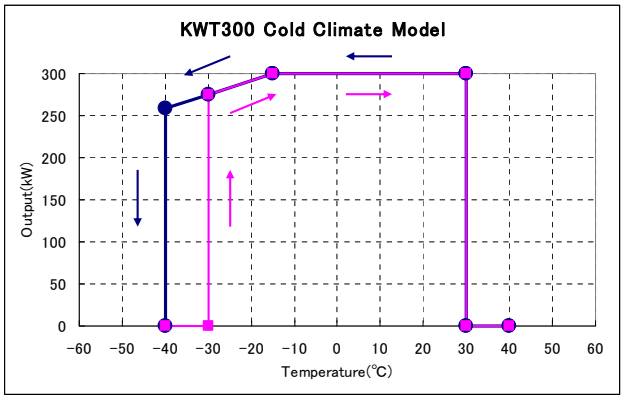


②Adopting Ultrasonic Anemometer for preventing icing and withstand snowfall

-Cofirmation using wind tunnel under -12℃, wind speed 1 m/s and 6 m/s

-No Icing of Ultrasonic Anemometer in the Ust-Kamchatk site

In National Research Institute for Earth Science and Disaster Resilience



③ Operation control system under low temperature

-safety and automatically shut down in lowest temperature

-generating power control for load reduction by increasing of air density under low temparature

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Cold Climate Model of KWT300 cont.

Blades Icing is the most serious issue under cold climate condition

- Standard treatment

To Prevent water adherence with water repellent and hydrophilic coating

Addition

- KWT300's unique measures

To prevent icing by controlling wind turbine

- Install precipitation, snow fall and humidity sensors
- Stop operation when icing probability is high judged by the measured values with sensors
- Slow the motion of cut-in and cut-out when the air temperature is low

Other measures

Temperature control of Nacelle	・Keep operating temperature by increasing heating capacity ・Add insulation and fan heater
Change materials and parts	・Steel of tower and hub ・Rubbers and oil and grease ・Gearbox and hydraulic system ・Rubber cover of cables ・Ultrasonic anemometer and wind vane
Load increment	・Power output control with rotor speed control under -15 C. Structural design modified to bear the increased load

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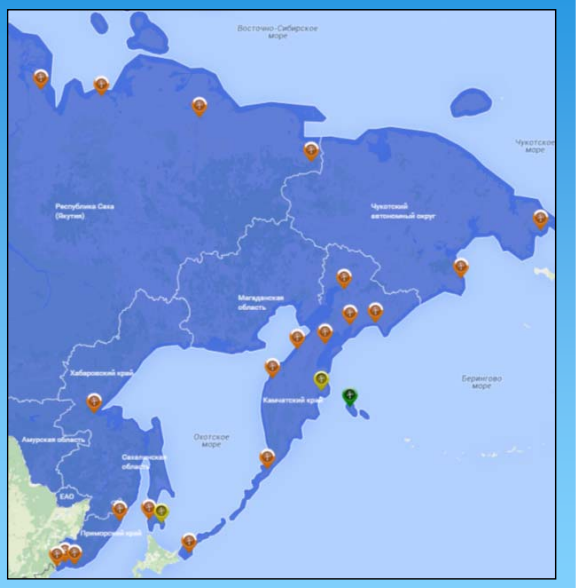
Remote off-grid areas of the Russian Far East

Potential sites of the wind power system supply in the Remote off-grid area in Far East of Russia.

1. Kamchatka
2. Yakutia
3. Chukotka
4. Khabarovsk
5. Primorye
6. Sakhalin



Source: RAO ES of East website

Collaboration Research
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Mr.Dmitry Prokolov

Study on Energy Management with Wind Power Generating System for the decentralized communities in Far North East

Renewable Business Department, KOMAIHALTEC Inc.

FOR MORE INFORMATION PLEASE CONTACT:

MITSUI & Co., Ltd.
Representative office of Mitsui & Co., Ltd.
in Khabarovsk
https://www.mitsui.com/jp/en/index.htm

KOMAI HALTEC Inc.
Renewable Energy Business Department
renew@komaihaltec.co.jp
http://www.komaihaltec.co.jp

11