GE Renewable Energy's Cold Weather Solutions

Be winter ready to ensure the operation of your turbines

How does winter weather impact the operation of your turbines?

Weather conditions are unpredictable in any part of the world but it generally arrives in any combination of four forms: cold temperatures, sleet, snow and ice. Cold temperatures affect the viscosity of various lubrication systems used throughout the wind turbine as well as some electrical components. Frozen precipitation affects components exposed to the elements such as blades and anemometers. Not properly managing the impact of these conditions can lead to significant impact on the power output of your wind farm.

Discover GE's Cold Weather Solutions: How can GE help to keep your turbines running?

GE's Cold Weather Solutions Consists of Two Solutions

1 Cold Weather Extreme Retrofit

GE Renewable Energy wind turbines are available from the factory with either a Standard Weather (STW) or Cold Weather Extreme (CWE) package. Standard Weather turbines have a minimum operating temperature limit of -15°C (5°F) while the Cold Weather Extreme turbines have a minimum operating temperature limit of -30°C (-22°F).

The operating temperature limit of GE wind turbines depends on the following components:

- Tower
- Grease
- Hydraulic oil
- Electrical components in:
  - — Pitch cabinet
  - — Top box
  - — Down Tower Assembly / Master Control Cabinet
  - — Anemometer
- Gearbox
- Generator
- Converter
- Control parameters

For CWE turbines, the electrical components, gearbox and generator are designed to survive, not operate, down to -40°C (-40°F) and utilize heating systems to reach proper operating temperatures prior to turbine start, as well as maintain proper operating temperature during cold weather operation.

In response to the need for expanding the operating envelope of our Standard Weather turbines, GE Renewable Energy has created a Cold Weather Extreme Retrofit.

How does it work?

GE works with the site to evaluate currently installed components and tower operating temperature limits. At the conclusion of this evaluation, if the tower can operate below -15°C (5°F), GE defines a list of modifications necessary so that the remainder of the components can safely operate at the lower temperatures.

GE Control System Monitoring for cold weather operation

Ensuring proper operating temperatures for these components is necessary for the safety and reliability of GE wind turbines and is achieved through temperature sensors and monitoring logic. If the turbine is outside of the allowable temperature range, the monitoring logic prevents the turbine from proceeding to a higher operating state, and conducts health checks where warnings and faults can occur.

② Winter Ice Operation Mode (WIOM)

Cold weather impacts on your blades

- Ice formation on blade
- Ice shedding
- Freezing of other components

} Leading to a loss of power and thus loss of money

Blades work with aerodynamics; therefore if your blades are impacted by anything it will have consequences on the wind turbine and will decrease the energy production.

For example, ice formation on the blade will impact the aerodynamics as it modifies the shape of the blade, which will slow down or stop spinning. Because of the weight of the ice, it can change the loading on the blade and the blade becomes out of balance.

As such, it's important to maintain and improve the energy production during winter.

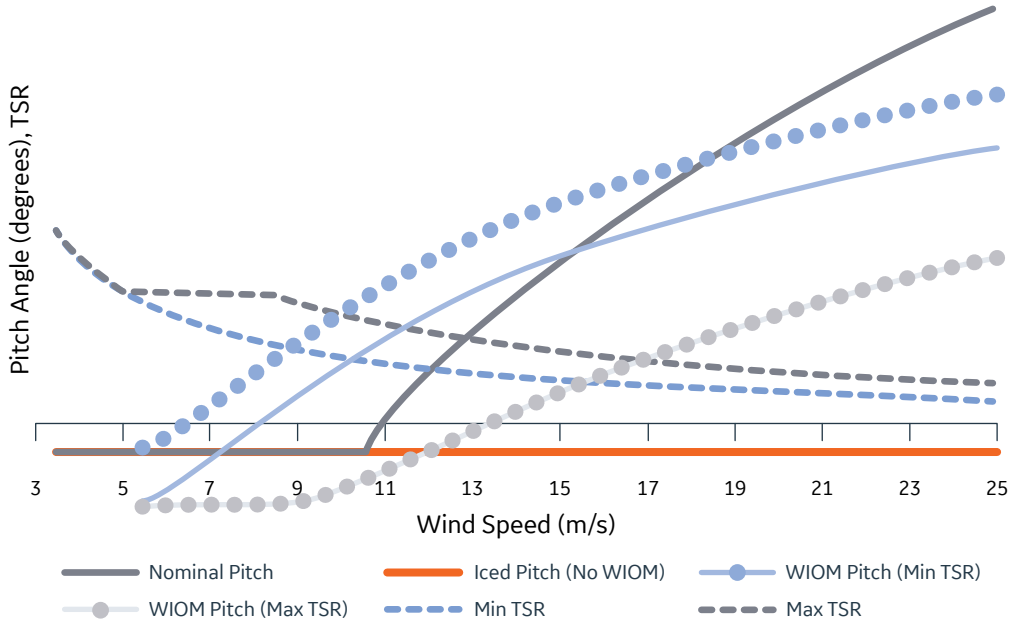
To prevent and ensure the efficiency of your turbines enable the Winter Iced Operation Mode for a permanent solution.

How does it work?

The WIOM algorithm detects this reduced output and adjusts blade pitch to allow the flow to reattach and return power generation closer to the original power curve. WIOM helps recover AEP losses when icing occurs on the blades by optimizing pitch controls to provide stall mitigation and avoid turbine overspeed events once ice is shed from the blade.

Turbines recover 1/3 or more of icing-related losses.

The impact on the power curve is illustrated in **the graphic below**.



Interested in Cold Weather Solutions?

Contact your GE Sales Representative to find out what cold weather options are available for your wind farm.

About GE Renewable Energy

GE Renewable Energy is a global leader in advanced technology focusing on wind, hydro, and solar power generation services for a cleaner, more productive world. Combining onshore and offshore wind, hydro and innovative technologies such as concentrated solar power, GE Renewable Energy has installed more than 400 GW capacity globally to make the world work better and cleaner. Our tailored solutions range from single component to full turnkey power plants.

Contact your Digital Services Sales Leader for more information on gaining more insights into your wind farm.

www.gerenewableenergy.com

GEA35089 | 02/2022