1.0 Introduction

IEA Wind Task 19 Wind Energy in Cold Climates began work in 2002 to address the special issues for wind turbines operating in cold environments. Areas where icing events (Icing Climate) or periods with temperatures below the operational limits (Low Temperature Climate) of standard wind turbines occur, may impact project implementation, economics, and safety. In some areas, wind turbines are only exposed to either icing or low temperature events. In some regions both low temperatures and icing events may take place. Although theoretically possible, active icing rarely occurs at temperatures below minus 25°C.

Wind resources in cold climate areas are typically good, making them attractive for wind development. However, icing and low ambient temperatures pose special challenges for wind energy projects. Icing of wind turbine rotor blades reduces energy yield, shortens mechanical life time of turbines, and increases safety risk due to potential ice throw. Low temperatures can affect a turbine’s mechanical lifetime if they are not taken into account in turbine design by using appropriate materials. Cold climate areas have gained more focus recently in attempts to reach higher wind energy targets. Also, increased experience, knowledge, and improvements in cold climate technologies have made projects in cold climates more competitive with standard wind projects.

The current wind capacity operating in cold climates in Scandinavia, North America, Europe, and Asia is approximately 60 GW; however, only a small portion of this wind turbine fleet is designed for icing and low temperature conditions. The potential to install new capacity in cold climate areas is vast and it is estimated that the capacity will increase, especially in Canada, the northern United States, China, and in northern Scandinavia. IEA Wind Task 19 estimated in 2013 that a capacity of nearly 10 GW is being installed annually at cold climate sites. This means that the stimulus for further development of wind power projects and technology in cold climate areas is strong.

To meet the demand for cold climate installations, turbine manufacturers have developed technical solutions for low temperatures of their standard turbines. In addition, first-generation commercial solutions for de-icing of wind turbine blades have entered the marketplace. R&D activities have been conducted in a number of countries to master the difficulties that atmospheric icing and low temperatures create. These research activities aim to improve the economics of wind power at new areas around the globe. The coming years are important to validate the fresh information and knowledge, and to analyze the performance of the adapted technologies arising from the wind energy projects going on, as well to gather more information to be publicly available.

Table 1 shows the countries and organizations participating in Task 19 during 2013. The group collects, evaluates, and creates information covering all aspects of wind energy in cold climates. For example, the group is working on site assessment in icing conditions, clarifying the economics of cold climate wind projects, and improving health and safety issues and procedures.

2.0 Objectives and Strategy

The objectives of Task 19 are as follows:

- Determine the current state of cold climate solutions for wind turbines,
- Collect, evaluate, and create information covering all aspects of wind energy in cold climates.
especially anti-icing and de-icing solutions that are available or are entering the market
- Review current standards and recommendations from the cold climate point of view and identify possible needs for updates
- Find and recommend a method for estimating the effects of atmospheric icing on energy production, because the commonly used standard tools do not address issues specific to cold climates
- Clarify the significance of extra loading that ice and cold climate induce on wind turbine components
- Perform a market survey for cold climate wind technology, including wind farms, remote grid systems, and stand-alone systems
- Define recommended limits for the use of standard technology (site classification)
- Create and update the Task 19 state-of-the-art report and expert group study on guidelines for applying wind energy in cold climates

The items above have been identified as key topics that are slowing wind power development in cold climates. The ongoing national R&D activities in task participant countries contribute to tackling these challenges and provide new information and know-how on the subject. The results of national activities will improve the overall economy of wind energy projects in cold climates and thus significantly lower the risks of developing in areas where low temperatures and atmospheric icing occurs.

The collaboration actively disseminates results through speakers at conferences, seminars, and workshops as well as through the Task 19 website at (www.ieawind.org). During 2013, members of Task 19 were invited as speakers and chairs in numerous seminars, conferences, and workshops dealing with wind energy in cold climates.

### 3.0 Progress in 2013

In 2013, the task gained valuable participants when China (represented by the Chinese Wind Energy Association) and Denmark joined and began contributing to the work plan. Also in 2013, Task 19 contributed to a landmark market study of cold climate wind energy. The study used sophisticated analysis and global coverage to make its projections. The study was published as a special chapter in the 18th edition of the annual market analysis, World Market Update 2012 (Navigant 2013). The results and conclusions have been referred to in numerous articles, presentations, and publications. The market study concluded that the wind energy market potential in cold climate areas is huge; 20% of all installed capacity in the world is installed in areas classified as cold climates, experiencing either icing or low temperatures or both. Table 2, copied here from the Navigant 2013, presents the total installed and forecasted capacity in cold climates and Figure 1 shows how the capacity is distributed around the world.

### 4.0 Plans for 2014 and beyond

The main goals for 2014 and 2015 are to update the Recommended Practices by verifying the recommendations based on accumulating experience and data collection. Key topics will be cold climate site classification, methods for energy yield estimation, harmonizing health and safety recommendations with respect to icing conditions. The task will also update the State-of-the-Art report on cold climate wind energy. Task 19 will have two meetings in 2014, the first one in Canada in June and the second one in Europe in fall. New results, publications, and reports can be found online at www.ieawind.org Task 19 Wind Energy in Cold Climates.

### Table 2. Total installed and forecasted capacity in cold climates

(Source: Navigant 2013)

<table>
<thead>
<tr>
<th>Cumulative installed capacity by end of 2012 (MW)</th>
<th>Forecasted capacity 2013–2017 (MW)</th>
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<tbody>
<tr>
<td>Low temperature Light icing: safety risk, some economic risk</td>
<td>Moderate to heavy icing: economic and safety risk</td>
</tr>
<tr>
<td>Low temperature Light icing: safety risk, some economic risk</td>
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<tr>
<td>18,945 41,079 11,478 20,025 22,083 8,003</td>
<td>Total 69,000* Total 45,000–50,000</td>
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*The total capacity is less than the sum of individual capacities because some of the sites have both low temperatures and icing conditions.

### Reference:


Author: Tomas Wallenius, VTT Technical Research Centre of Finland, Finland.