Borealis Wind

Winterwind 2021

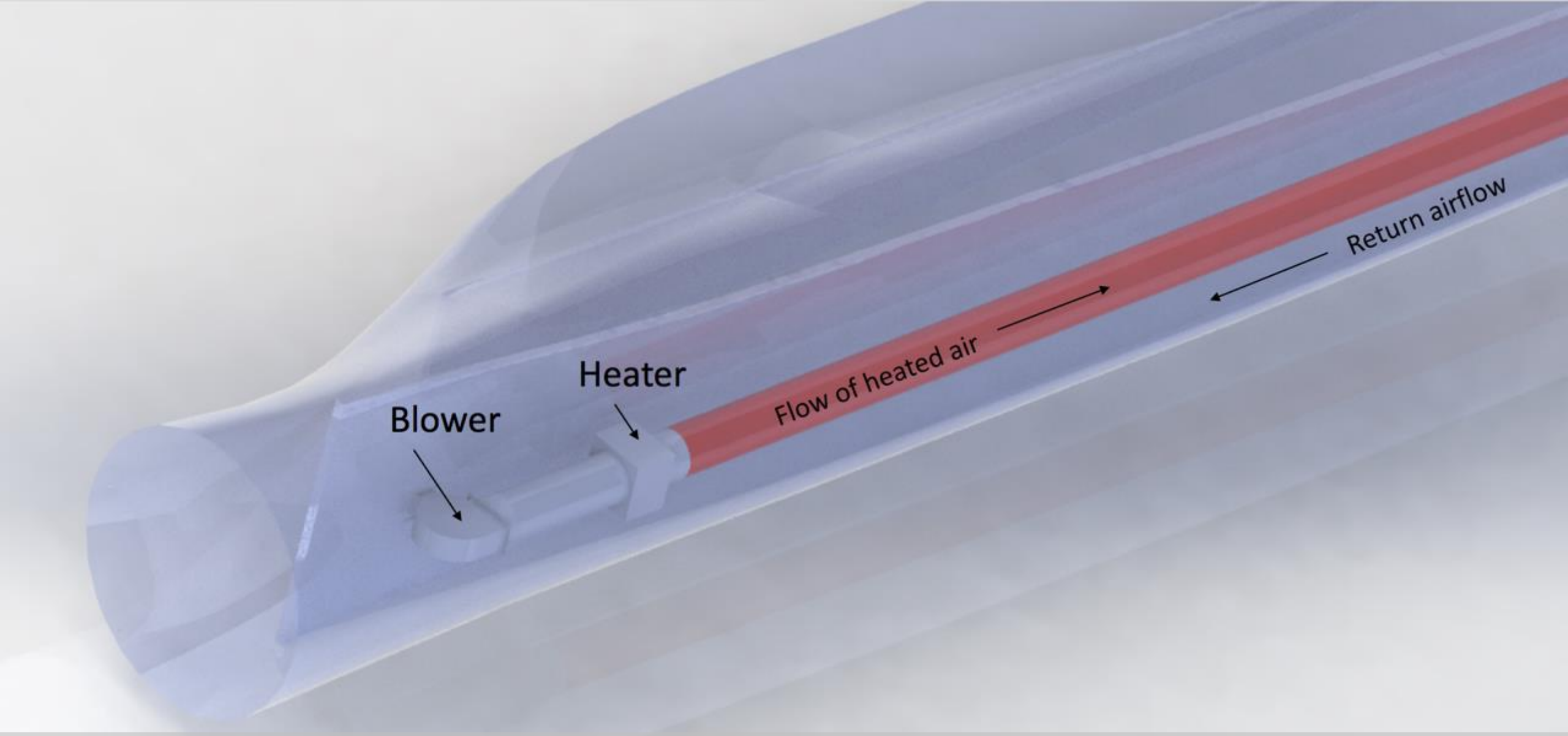
IPS Retrofit for Complex Blades

www.borealiswind.com
info@borealiswind.com

Borealis Wind provides a retrofit blade heating system to prevent and remove ice buildup

Est. April 20, 2016

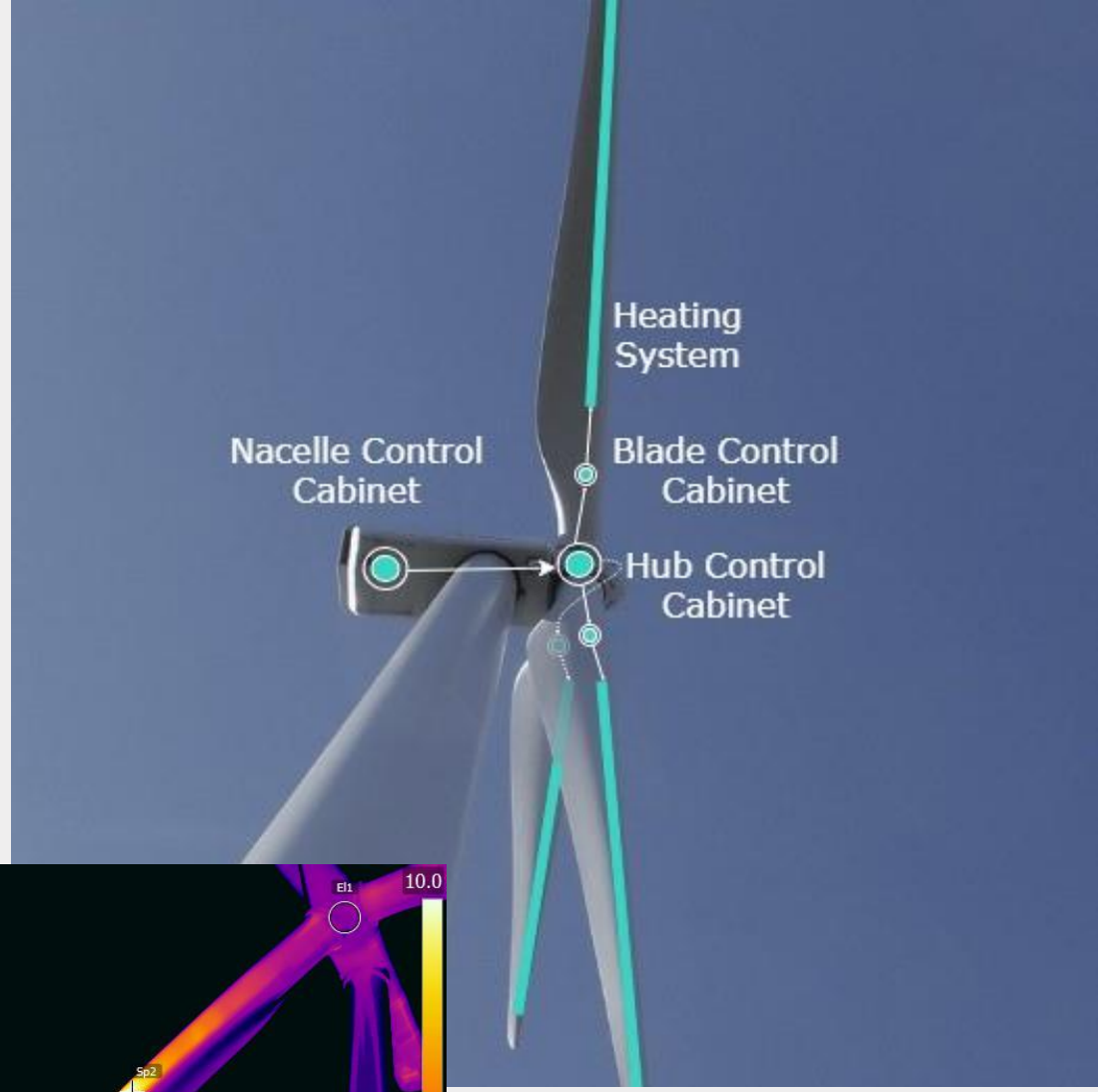
First installed in 2018 and have since retrofitted 9 turbines at 5 different wind farms in Canada

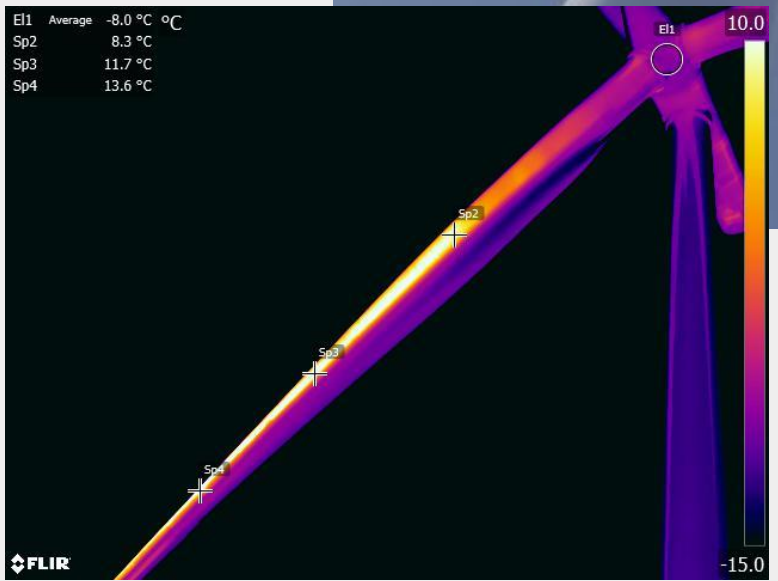


Borealis Ice Protection System

System details

- Borealis IPS
  - Nacelle control cabinet
  - Hub control cabinet
  - Blade control cabinet
  - Heating system
- Optional Feeder Circuit
  - Additional 100 kW to hub
  - Power cable from basement to nacelle
  - Upgraded slipring





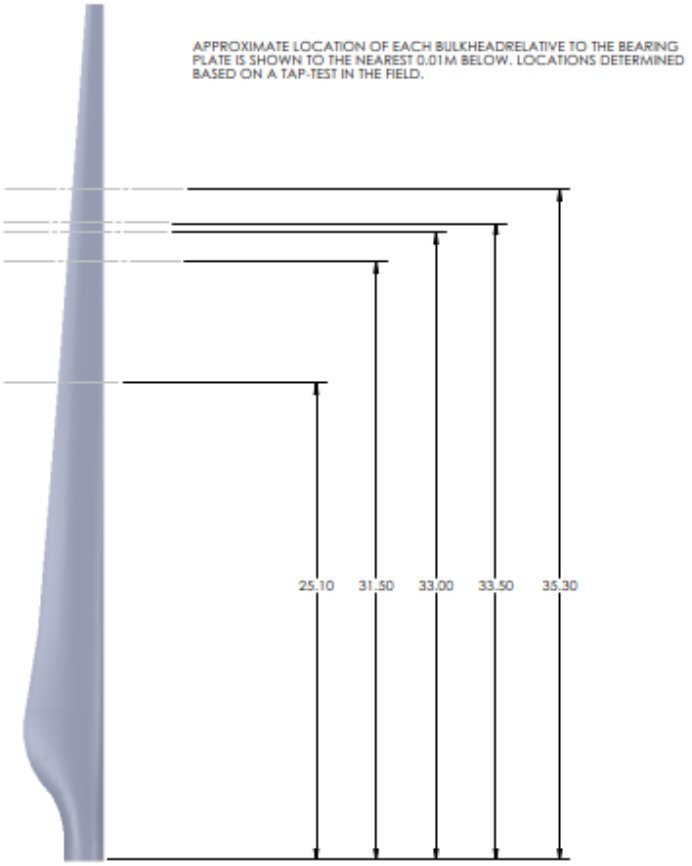
System Installation

- 9 days to retrofit the Borealis System
- Performed by positioning each blade horizontally
- Schedule is designed to have the turbine operational overnight
- Can be installed during any season
- All materials are sized so they can be easily passed into the blade
  - Less than 50 cm x 50cm in cross section
  - Less than 70 lbs.

Problem Statement

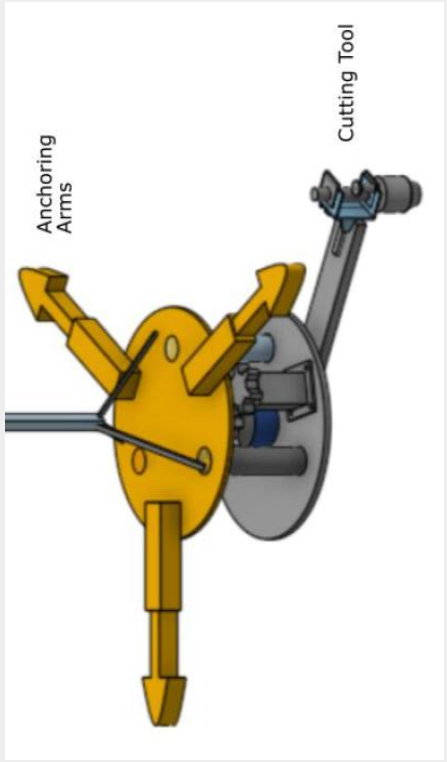
- Some blades have obstructions preventing airflow from reaching the tip of the blade
  - Complex Blades
  - Bulkheads

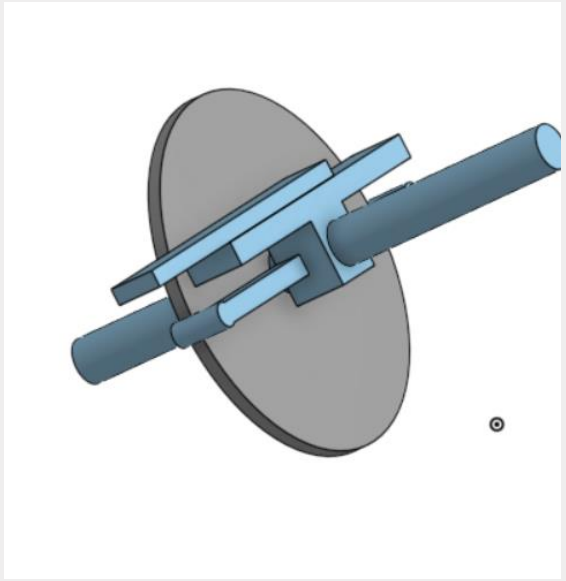
- Objective: Develop a tool to modify the internal obstructions to allow airflow to the tip of the blade, without impacting the structure of the blade

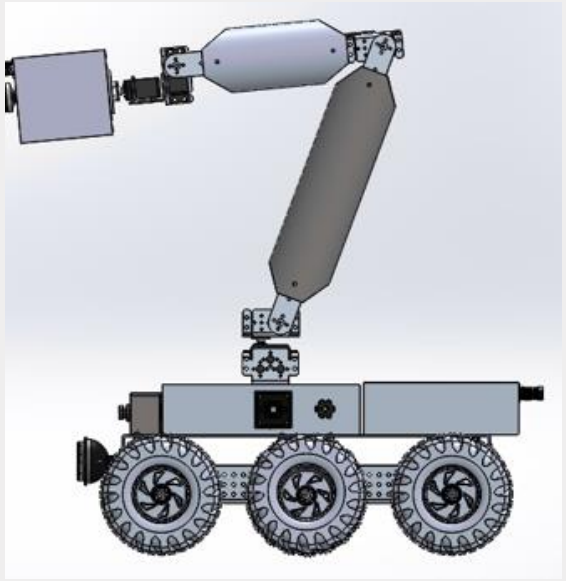


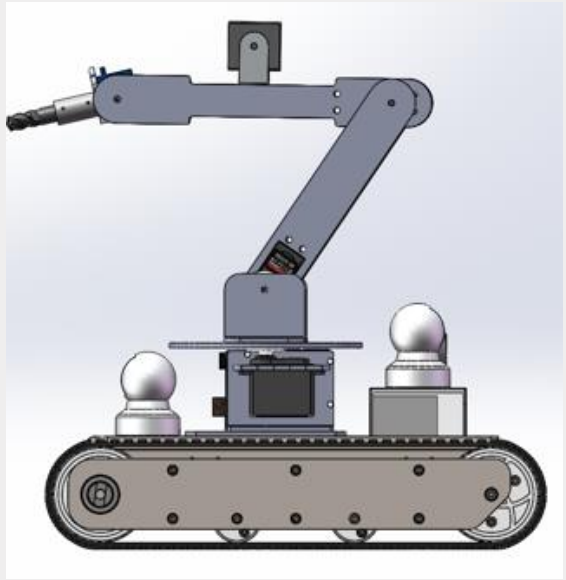
Concepts for Modifying Complex Blades (2018)

- Began collecting information in fall 2018
- Started concept generation winter 2018/19



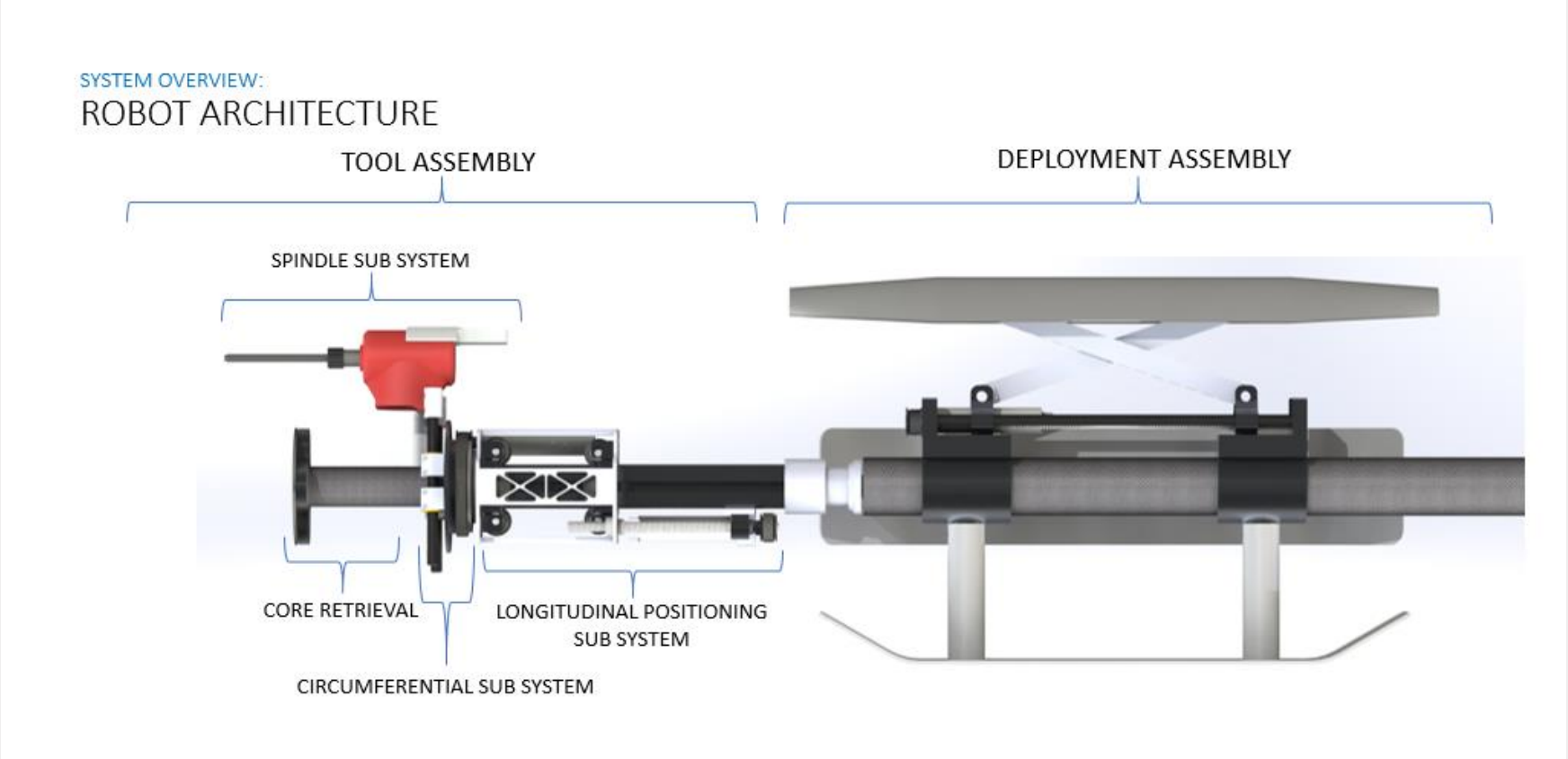




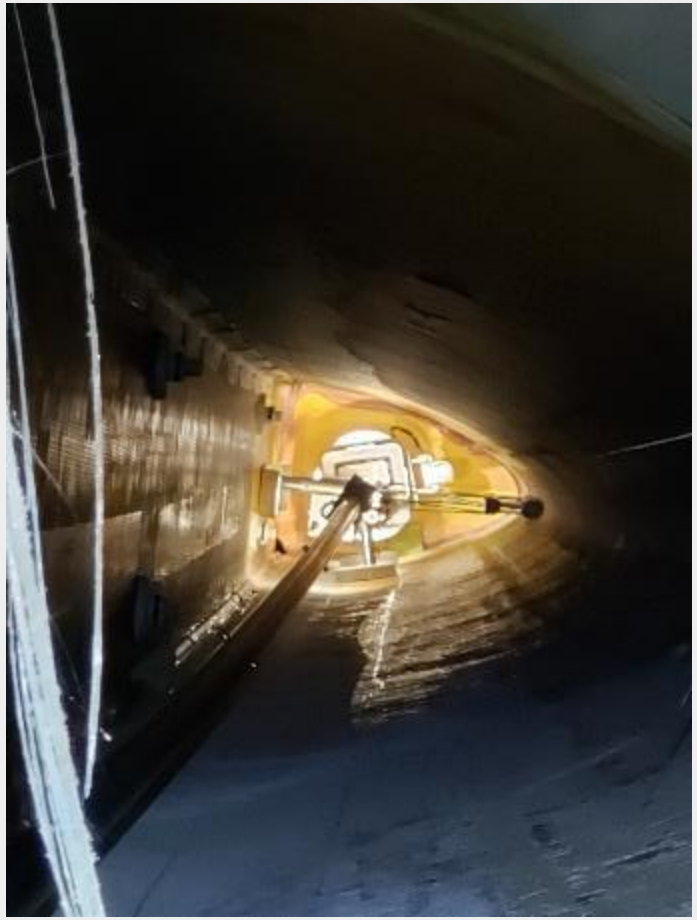


Selected Solution Developed (2019)

- Contracted ULC Technologies in fall 2019 to fully develop the solution



First Field Test – August 2020

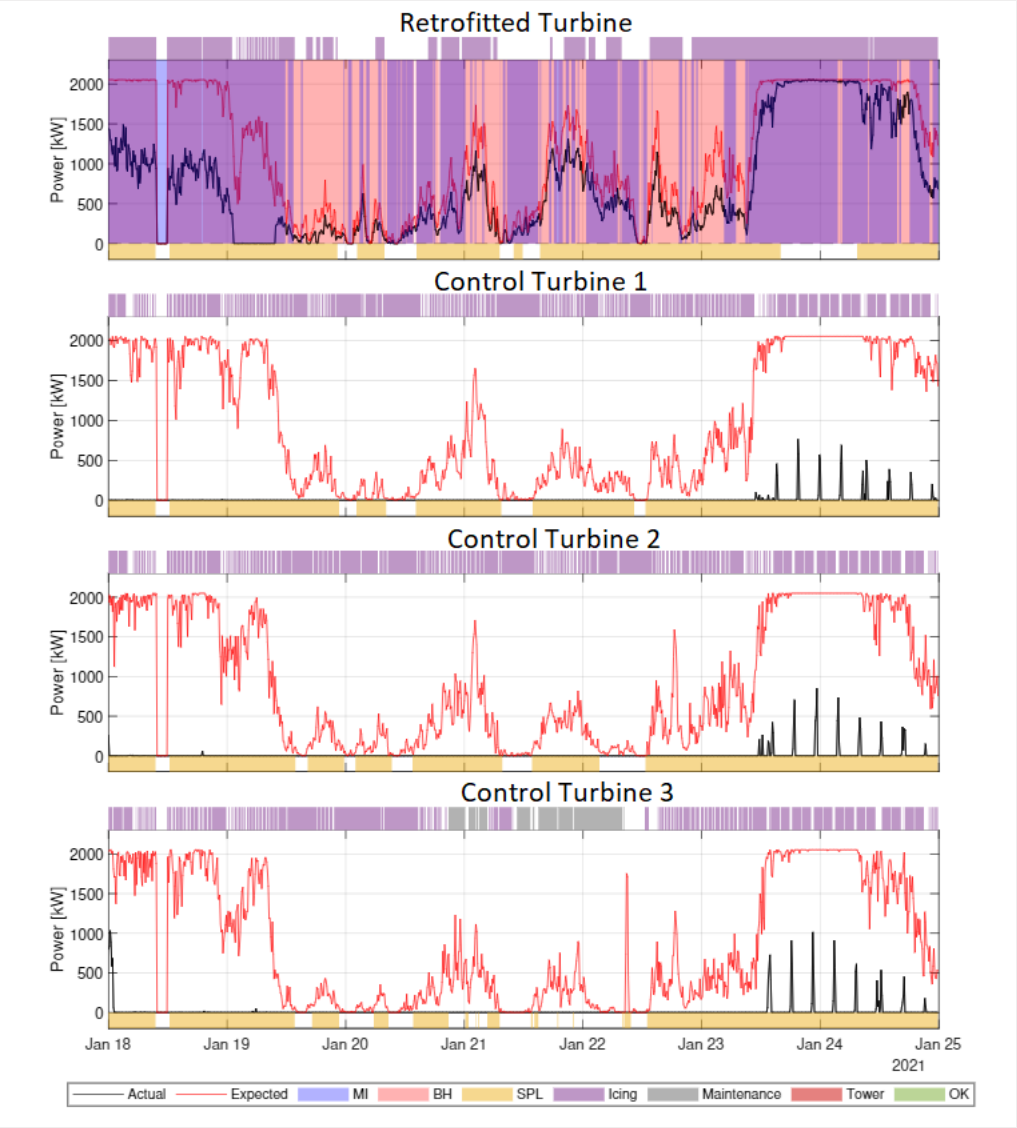


Pilot Program – November 2020

- November 2020
- All bulkheads were successfully removed
- Borealis IPS installed and commissioned as of December 2020

Borealis IPS in Complex Blades Performance

- Data analysis prepared by Université Laval research group led by Prof. André Bégin-Drolet
- 105 MWh recovered this week alone
- 61% recovery over the entire week



Next Steps

- Commercializing the complex blade tool in 2021
- Commercial production of the Borealis IPS as of April 2021
  - Continual efficiency improvements to the control system for the Borealis IPS
  - Expansion into international markets outside of Canada

Summary

Borealis Ice Protection System:

Retrofit blade heating system

Complex Blade Solution:

Developed tool with ULC Technologies to modify complex blades to allow airflow to the tip of the blade

Validation:

Validated the complex blade system during the pilot in 2020/21

Next Steps:

Commercialization of the tool is underway for use in 2021

Borealis IPS is in commercial production

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