



# ETC wind turbine blade erosion testing problem

Energy Technology Centre Ltd (ETC) provides testing facilities and expertise for renewables technology. One of its core services, water droplet erosion testing for wind turbine blades, is important for manufacturers of blades and protection systems.

Damage from water droplet erosion can reduce performance and lead to 3-5% power losses and repairs and replacements are costly, particularly in offshore environments. Reducing erosion has a big economic benefit.

## Challenge

Testing compares materials under the same erosion conditions, showing which are most durable. The blades are placed in a test rig where they spin on an arm to simulate normal operating speeds and are struck with water droplets,

simulating the erosion mechanisms experienced in operation on an accelerated time scale. This allows them to compare materials and coatings to identify the most durable designs. However, there are many unknowns around how testing conditions relate to real life.

Assessing the materials under test currently involves stopping at discrete intervals for visual inspections and making mass loss measurements. This only shows what the damage is, but not how and when it occurred. It is also a laborious and time-consuming process and some evidence suggests that stopping and starting compromises results.

ETC wanted to improve their testing by developing a system that could monitor erosion throughout testing and make assessments based on more reliable indicators. This was no small challenge, since it required detecting micrometre level changes in blades moving at up to 150 m/s.

ETC were not aware of any such technique, so they applied to the Analysis for Innovators (A4I) Programme to investigate a possible solution.



## A4I solution

NPL saw potential in a technique they had developed for evaluating high temperature particle erosion monitoring in power stations. This used optical measurement methods to measure material loss by volume as the material was being bombarded by particles. NPL made small modifications to the measurement technique to adapt it to wind turbine blade measurements. This was combined with a high-speed camera and software was created to interrogate the vast amounts of data generated by the camera images.

The instrument was tested on ETC's rig using blade sections with well-understood introduced defects. The technology was shown to measure the known defects correctly, down to a couple of micrometres. This successfully demonstrated the possibility of making measurements of the size and shape of damage caused by erosion during testing.



## Impact

The initial feasibility study proved the concept, but more work is needed to adapt measurements for the range of turbine blades surface shapes and finishes. ETC are now looking for partners and funders to take this project forward.

**If they are successful, this new instrument will create significant competitive advantage for ETC, giving them much greater insight into erosion mechanisms than other test labs.**

This in turn will help the wind industry to better understand optimal design, material selection and coatings for their blades to increase lifetime and improve efficiency.

**“ When we applied for A4I, we were hopeful we would be partnered with NPL. We knew about their world-class expertise in measurement - if anyone could find a solution to this difficult measurement challenge, they could. One of the reasons they stand out is the breadth of measurement and materials expertise across different sectors. This proved invaluable, as they were able to identify solutions applied to other materials challenges and bring them to bear on our problem, whilst also bringing knowledge of the nuances of wind turbine testing, enabling them to make the appropriate modifications to apply their technology to our specific challenge. ”**

**Dean Boyce**

Senior Engineer at the Energy Technology Centre



## A4I

A4I is a programme that gives UK businesses, of any size, access to cutting-edge R&D expertise and facilities to help solve problems that they have been unable to tackle using standard techniques. The focus is on solving issues affecting product cost, reliability or lifetime and production problems.



Science & Technology  
Facilities Council

Innovate UK  
Knowledge Transfer Network