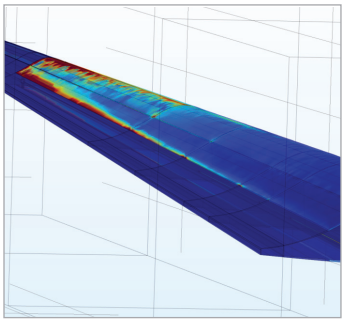
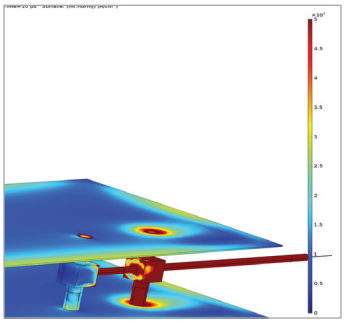
NTS MARKET SPOTLIGHT

WIND POWER



Full Blade Current Density



Current Transfer between Down Conductor and SPL

SPECIALISTS IN LIGHTNING PROTECTION

NTS has been involved in the wind power industry for over 30 years, even participating in the committee responsible for releasing the wind industry test standard IEC 61400-24. By combining involvement in the IEC TC-88 PT 24 committee with the growth of in-house analytical modeling capabilities, we are able to provide design evaluation and testing services for wind power products.

LIGHTNING ENGINEERING AND IEC 61400-24 TEST CAPABILITIES

Protection Design

- Blades including traditional makeup, CFRP makeup, anti-ice/de-icing technology, electronic systems and control devices
- Supervisory Control and Data Acquisition (SCADA)
- Control Electronics
- Power Distribution
- Structural components including hubs, spinners, nacelle, mechanical drive train and yaw control systems, tower installations, grounding and equipotential bonding

Numerical Simulation Services

- Blades with Candidate Protection Designs using COMSOL Multiphysics
- Blade, Hub, Nacelle, Tower and Earthing Installations to predict responses to lightning strikes and performance of protection designs
- Evaluation for protection devices (SPD, TVS, Shielding, etc.)
- Exposure assessments – Zoning (LPX) per IEC 61400-24
- Damage Risk Assessments on/off-site turbine inspections for incident investigation
- Retrofit Design Services

Protection Verification Services

- Certification Test Planning and documentation
- Direct Effects Test conducted on blade specimens up to 15 meters in length, in accordance with Annex D of IEC 61400-24
  - » High Voltage Strike Attachment Test
    - – Initial Leader Attachment (Type A and Type B test methods)
    - – Swept Channel Attachment
  - » High Current Physical Damage Tests
    - – Up to 200 kA with 6 MJ and 300 C via arc entry and conducted current

NTS

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COMSOL ANALYTICAL MODELING FOR TURBINE SYSTEMS AND STRUCTURES

NTS has developed electromagnetic models for wind turbine blades, analyzing distributions between structural carbon and surface protection layers, determining transient voltages and currents to optimize lightning conductor locations, tolerances and more.

Development and Replication Methodology

We can determine what is electromagnetically important, such as the voltages or currents induced throughout the blade, including CFRP pultrusions, heater elements, surface protection layers, and down conductors. Models capture critical design details such as material thicknesses, conductor routing and receptor locations.

Analysis and Validation Methodology

NTS engineers conduct analyses to evaluate current distributions for candidate protection designs. IThe model dataneeds to be validated by replicating the measurements taken during testing and comparing them to the analytical data to determine correlation. Such tests typically include:

- High voltage strike attachment tests on a wing tip to determine likely attachment points, puncture possibilities, and internal streamer locations
- High current physical damage tests on a ~1m2 panel to determine current conduction efficacy of embedded lightning protection materials
- Induced transient tests on internal wiring harnesses to determine induced voltage/current amplitudes and to evaluate the potential for damage to installed electrical equipment

Turbine Blade High Voltage Test

Comparisons

Comparisons are captured in a detailed Validation report that serves as the "Go or No Go" portion of the projects. If the model shows sufficient agreement with the measured data, it can then be said that the model is an appropriate representation of real test article. If the model does not show agreement, alternative modeling approaches can be taken, or the project can pause to reduce program risk. Experience to date has shown good correlation between model and measured data.

Validation and General Purpose

Once the model has been validated, it is returned to a general purpose setup. The boundary returns are used to remove any test setup specific artifacts that may have been included, and physics and boundary conditions are not changed. The model can then be manipulated without undergoing further tests allowing for the examination of identified design changes warranted by initial model computations/data validation tests, and understanding transient levels on conductors and electronics, etc.

Fully Developed Models

Early life cycle modeling reduces certification risks, verifies design methodologies for future designs, and allows for similarity analyses on future designs to reduce testing needs. The NTS modeling and analytical team works in tandem with our engineering services team, assisting in the selection of materials and connection methods that are the most likely to be robust and require less repairs post-lightning strikes. Additionally, protection design materials and features—such as connections, SPL and ETH pads—are evaluated to sustain effects of multiple strikes. In short, analytical models are shown to reduce project life cycle testing costs, and provide insight for key design decisions.

About NTS

As one of the largest commercial test laboratory networks in North America, NTS offers test, inspection and certification services for environmental, dynamics, EMC, wireless, product safety, materials, ballistics and much more. Our client partners rely on NTS to bring quality products to market quickly and efficiently, and so can you.

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