CONVIVIUM
RENEWABLE ENERGY

KIRK W. STOPENHAGEN

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Consulting Meteorologist, Wind Resource Assessment, Air Quality Monitoring& Modeling

Education
Bachelor of Science in Meteorology, North Carolina State University (1981)

Professional
American Meteorological Society

Air & Waste Management Association

American Wind Energy Association

Publications
With Kenneth Cohn and Michael Meyer, *An Improved Cup Anemometer for Wind Resource Assessment Wind Speed Measurements.* Presented at the American Wind Energy Association Annual Conference, Dallas, TX, May 2010

With Robert Baker and John Wade, *Calibration of a Mini Sodar and Determination of Shear at the Klondike Wind Farm.* Presented at the American Wind Energy Association Annual Conference, Denver, CO, June 2005

With McGregor, Castleberry and Newvine, *On-Lake Air Quality and Dust Control Effectiveness Monitoring on Owens (dry) Lake.* Presented at the 94th Annual Meeting, Air and Waste Management Association, San Diego, CA, June 2003

With Tom Pottberg, *An*

Profile

Kirk Stopenhagen is a meteorologist with over 29 years experience as a consulting meteorologist. Mr. Stopenhagen conducts wind resource assessment and due diligence studies for wind farm developers and private industry. This requires siting met towers and collecting, reviewing and analyzing meteorological data sets to determine the feasibility of developing wind energy projects. He is experienced in windflow modeling, evaluating site conditions and turbine micrositing. He has conducted numerous wind studies using Doppler SODAR to measure vertical wind profiles and compare SODAR data with nearby towers to evaluate wind shear.

His air quality experience includes meteorological and ambient air quality monitoring, modeling, and permitting. He has managed monitoring programs, operated and maintained instrumentation, provided hands-on training and produced data and quality assurance reports for numerous meteorological and ambient air monitoring networks. He is well versed in United States Environmental Protection Agency (EPA) and individual states' unique quality assurance requirements. He has authored numerous ambient air monitoring and quality assurance plans. His skills include design, site selection, installation, operator training, data analysis, auditing, and maintenance and repair of ambient monitoring networks. He has directed quality assurance efforts and conducted systems and performance audits for ongoing ambient monitoring programs.

Experience

Mr. Stopenhagen started his own meteorological and air quality consulting firm, Vorticity Consulting, LLC in January 2007. The business structure enables him to be flexible by contracting directly to clients or as a contractor to Chinook Wind, a wind energy consulting firm. Mr. Stopenhagen continues to work for numerous clients with whom he developed working relationships over the past 29 years.

Selective Vorticity Consulting Projects

Chinook Wind | January 2007-present

Mr. Stopenhagen is the contract meteorologist for Chinook Wind. He provides consulting services to clients for meteorological analysis of wind energy projects. He conducts wind resource assessments, site condition studies, due diligence, windflow modeling, micrositing, senior review for private developers and both private and public utilities. He is a recognized expert using SODAR vertical wind profiling for wind farm development, and Greenfield prospecting.

October 2009-present

Mr. Stopenhagen has been assisting an aerospace manufacturer to calibrate and audit two 15-meter meteorological stations at two separate facilities in the Puget Sound region. This is a continuation of work done by Mr. Stopenhagen for this client over the past 18 years.

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Optical Particulate Matter Monitor for Extreme Environments. Presented at 93rd Annual Meeting Air and Waste Management Association, Salt Lake City, UT, June 2000

With Howes et al, *Ambient Lead Measurements in Cairo, Egypt*. 92nd Annual Meeting, Air and Waste Management Association. St. Louis, Missouri, June 1999

With Lindsay, Gravley, Boedigheimer, & Graziano, *Monitoring for Hydrogen Chloride in Ambient Air*. 88th Annual Meeting, Air and Waste Management Association. San Antonio, Texas, June 1995.

January 2009-present

For Convivium Renewables, Mr. Stopenhagen has provided wind energy analysis and critical review of wind resource assessments and provided technical support on wind measurement campaigns and SODAR measurements.

January 2009-present

Vorticity has been working with a paper mill in Western Washington to modernize an ambient H_2S, SO_2 and meteorological monitoring network required by a local County Board of Health. This is a continuation of work done by Mr. Stopenhagen for this client over the past 15 years.

January 2008-present

Mr. Stopenhagen has been assisting a lumber mill in Western Oregon to collect a PSD-quality on-site meteorological monitoring data set for future mill expansion. This included working with Oregon DEQ to obtain approval of the tower location and submitting a monitoring and quality assurance plan. Installation of the 13-meter met tower is pending. Data collection, reporting, data management, and quality assurance including performance audits will continue for a minimum period of 12 months.

October 2008-present

Mr. Stopenhagen has been assisting MetOne Instruments; an international leader in meteorological instrumentation, with testing and development of anemometers for use in the wind energy industry.

January 2007-present

Mr. Stopenhagen continues to provide meteorological station consulting services to a forest products company in Idaho. This includes station operation and quality assurance tasks associated with operating a 100-meter tall PSD meteorological station. This is the continuation of work for this client over the past 15 years by Mr. Stopenhagen while with his previous employer, CH2M HILL.

Past Experience

CH2MHILL, Inc Bellevue, Washington |1988-2006
Meteorologist/Air Quality Scientist
As CH2M HILL's Senior Technologist for Ambient Air Monitoring, Mr. Stopenhagen was responsible for coordinating Quality Assurance activities for wind energy, meteorological and ambient monitoring clients. He prepared proposals and facilitated project teams to deliver monitoring projects to industrial clients nationally and internationally. He mentored junior staff in project management and technical issues. Other air quality experience included; air quality permit applications including 1990 Clean Air Act Amendments, Title V, PSD, emissions inventories, continuous emissions monitoring equipment specification and RATA, air toxics issues, receptor and dispersion modeling, visibility and regional haze issues, and meteorological and air quality issues of concern in environmental impact statements.

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Selective CH2MHILL Projects | 1988-2006

Mr. Stopenhagen, was the senior meteorologist for a multi-year wind resource assessment project in remote, rural Alaska to determine the feasibility of an 80-100MW off-grid wind farm at a gold mine site. The project included siting, data analysis and reporting for seven met towers, WAsP and WindLogics modeling and conducting a tower/SODAR study to measure winds and determine shear at hub height.

Mr. Stopenhagen conducted a wind resource assessment study for a public utility in Nebraska. This included WAsP modeling, assessment of wind power potential within the utility's service area and recommendations for siting and collecting meteorological data.

Mr. Stopenhagen conducted a SODAR/tower comparison study for PPM Energy as part of the expansion of their Klondike Wind Farm in Oregon. Wind shear was determined by collocating the SODAR at two different tower locations. The results were presented at the 2005 AWEA conference.

For a manufacturer in Seattle, Mr. Stopenhagen managed a meteorological monitoring quality assurance program which included training, operational maintenance, troubleshooting and performance audits at two plant locations in the Puget Sound area.

For forest product and pulp and paper mills in Washington, Oregon, and Idaho, Mr. Stopenhagen managed projects to conduct site selection, performance audits, field personnel training in station operations, developed standard operational procedures for field operations and wrote Quality Assurance plans for Particulate Matter, Nitrogen Oxides, Sulfur Dioxide, Hydrogen Sulfide and meteorological monitoring stations. He managed multi-year projects to collect, report and analyze the data.

Mr. Stopenhagen was the lead technologist for design, training and operation of a 13-station network of PM_{10}, wind erosion and 10-meter meteorological stations on a dry lakebed in the eastern Sierra of California. This multi-year study collected data used for determination of compliance with NAAQS for PM_{10}. He was principally involved in interviewing and hiring the three-person monitoring project staff and served as the project's primary technical consultant and quality assurance officer for air monitoring issues.

Mr. Stopenhagen managed a project for a consortium of 14 petroleum companies in cooperation with public interest groups and the State of North Carolina's Air Quality Toxics Protection Branch to design, install, train and operate a seven-site meteorological and ambient air toxics monitoring program in Charlotte, North Carolina. The network collected 24-hour SUMMA canister samples of ambient air at each site for a 12-month field study. Over 1000 canisters were analyzed by EPA Method TO-14 for benzene, ethyl-benzene, toluene and m-,p- and o-xylenes.

Mr. Stopenhagen was the manager of a meteorological and ambient air toxics monitoring project in Valdez, Alaska. The project won National Finalist recognition in the 1992 American Consulting Engineers Council's national award competition. The project included; design, installation, operation, data reporting, QA/QC, and auditing for a five-site ambient air and meteorological monitoring network. Data gathered

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during this project was used as input for EPA dispersion modeling, risk assessment, and state and federal air quality permit compliance.

GeoResearch, Inc. Billings, Montana | 1984-1988
Meteorologist
Mr. Stopenhagen managed ambient air monitoring projects. He assisted in wind energy studies including preparation of the *Montana Wind Energy Atlas*. He managed four multiple site ambient monitoring networks in Montana and North Dakota. He compiled, analyzed, and validated monitoring data. Systems and performance audits were his responsibility, as well as providing training and technical assistance to regional clients.

Beak Consultants Denver, Colorado | 1982-1983
Air Quality Meteorologist
Mr. Stopenhagen was responsible for the operation of a PSD air monitoring network in remote Southwestern Wyoming. His duties included maintenance and upkeep of meteorological sensors on a 60-meter tower, SO_2 and H_2S ambient air analyzers, and visibility monitoring equipment.

Enviro-Test, Ltd. Lakewood, Colorado | 1981-1982
Air Quality/Meteorological Technician
Mr. Stopenhagen's work included conducting baseline fugitive dust studies, TSP and PM_{10} air monitoring and performance audits, air quality and meteorological data reduction, data analysis and data reporting; air quality source emissions testing at several surface coal mines.

References

Available upon request.