

Alaska Wind Program Guidelines for Conceptual Design Reports

These are the bare essential aspects that should be addressed when developing wind feasibility studies. Wind turbines are not a stand-alone component, but rather an energy source that must be integrated into an over-arching power generation and distribution system for the community. Conversely, a CDR with an overly broad scope wastes time and money and can make it more difficult to recommend next steps.

Wind Resource Study

- ☐ How reliable is the overall data? Are there gaps? Did any sensors or datalogger fail? Was a log sheet filled out during tower erection?
- ☐ How fast is the wind? Average speed, maximum, std. dev.?
- ☐ How does the wind speed vary throughout the day? Month to month?
- ☐ What does the wind speed distribution look like? Weibull K? Is it bi-modal with periods of calm then severe storms? Is the distribution more continuous?
- ☐ How does the wind shear change with elevation (power law exponent)? How turbulent is the wind? What are the predicted maximum speeds over 20 and 50 years?
- ☐ How much icing is experienced at the site? How thick is the icing and how long does it last?
- ☐ What is the air temperature and density?
- ☐ How consistent is the wind data from one year to the next? How does it compare with long-term trends?
- ☐ How was the met tower site chosen? Are there nearby obstructions?
- ☐ How does the wind speed and wind rose compare with the statewide wind resource model for that location?
- ☐ How closely will wind turbines be placed near the met tower site?
- ☐ How does the wind rose affect siting for multiple turbines?
- ☐ What issues were raised by the FAA and US Fish & Wildlife Service during the met tower permitting process?
- ☐ What is the estimated net production for turbines being considered, assuming no wasted/excess power? Windographer defaults to an 82% availability. This is a reasonable estimate.

Existing Electrical System Overview

- ☐ How does the community electrical load vary throughout the day? Month to month? What is the average, peak and minimum?
- ☐ Are there seasonal loads due to commercial or traditional activities? How do the residential electrical loads compare with industrial and commercial loads throughout the day and month to month? What are the station service loads?
- ☐ Are there existing diversion electrical loads in the community? Are there electrical loads that could be converted to dispatchable loads if needed?

- ☐ What is the make, model, kW rating and age of each diesel genset? What are the fuel curves for each unit? What type of mechanical or electronic throttle controls exist? What are the actual reported kWhrs per gallon of fuel for this facility?
- ☐ What kind of switch gear exists – make, model, manual/automatic? Can the existing system be expanded for the proposed wind turbine and secondary loads? What kind of SCADA currently exists?
- ☐ Are upgrades or replacements planned for any key system components?
- ☐ Is there a heat recovery system? What loads does it feed? How are those heat loads monitored/quantified? How much heat is lost in the system?
- ☐ Are there additional potential electrical loads in the community that are not currently being met? Are any new electrical loads being planned?
- ☐ Where are the major electrical loads located in the community from a geospatial perspective?
- ☐ How well are the phases balanced in the distribution system? How are the transformers in the community loaded or overloaded? Where is there phase or transformer capacity to add additional loads?
- ☐ What is the condition of the distribution lines, transformers and poles?
- ☐ Provide a map showing single versus three-phase power lines and varying voltage levels?
- ☐ What are the parasitic and other system losses?

Heat Loads Overview

- ☐ What is the heat recovery percentage of each diesel genset? What heat loads are tied into the heat recovery system? How are those heat loads monitored/quantified? How much heat is lost in the system? What additional capacity is available?
- ☐ Pull heating fuel consumption/purchase records (minimum one year) for the buildings being considered and provide annual estimates (high/low) for each. Provide building dimensions.
- ☐ What is the daily and month-to-month profile of each heat load? Preferred: use AEA's hourly heat load spreadsheet to generate heat data for HOMER modeling. AEA can assist in setting this up.
- ☐ If the heat load is a water treatment/storage/delivery system, provide details of annual fuel consumption records, storage tank size (gallons and dimensions) and insulation, distribution piping and distances, incoming water temperature in winter and summer, water system temperature target and maximum temperature set points. Use AEA's hourly heat load spreadsheet for water systems to generate a heat model for HOMER modeling.
- ☐ If the heat load is a washeteria, provide annual fuel estimates and number of washers/dryers/showers. Estimate daily and seasonal demand profile.
- ☐ Where are the major heat loads located in the community from a geospatial perspective? Which could connect to an existing or planned heat recovery loop? Which could be clustered together for a remote electric boiler?
- ☐ Are there additional potential heat loads in the community that are not currently being met? Are any new heat loads being planned? Where are they located relative to the powerhouse?
- ☐ What is the efficiency of current boilers? Where is space available to add electric boilers?

- ☐ What is the thermal mass in the heat load and how much excess energy can it temporarily absorb as a buffer?
- ☐ Run a HOMER model for the turbine types being considered comparing excess wind energy throughout the year and how that is aligned with the heat load profile(s).
- ☐ Are heat loads better served by connecting an electric boiler to the existing heat recovery loop or placing electric boilers in other community buildings?
- ☐ What are the trade-offs between a few large electric boilers versus numerous nodes throughout the community?
- ☐ What agreements are needed to establish heat sales with customers?

Compiling the Final Conceptual Design Report

In addition to answering all of the above questions, please provide the following materials in your report.

- ☐ Proposed electrical system line drawings showing turbines, transmission lines, distribution system and powerhouse. Label voltage and phase of lines, plus conductor type, size and resistance factor at 0 deg Celsius.
- ☐ How will turbine type, quantity and location affect power quality issues such as reactive power, power factor, voltage rise and other distributed generation issues? Does a basic voltage drop/rise calculation indicate the need for additional analysis using the DG Toolbox or running a load flow analysis? Is complex PSSE modeling required?
- ☐ Detailed line drawing showing how wind power connects to the powerhouse through switchgear and how wind, diesel and diversion loads integrate with each other.
- ☐ Proposed and existing SCADA system drawing and description.
- ☐ Proposed physical layout at turbine site, powerhouse and transmission route.
- ☐ Proposed and existing diversion load drawing and description.
- ☐ Wind turbine models, sizes and quantities considered. Power curves for each turbine. Which qualified third-party test facility has certified the proposed turbines?
- ☐ Proposed budget and schedule based on current turbine pricing and construction estimates.
- ☐ A list of what permits will be needed for the project.
- ☐ A copy of the geotechnical reconnaissance report.
- ☐ HOMER model with accurate wind resource, electrical load, thermal load, wind turbine power curves, turbine availability, diesel power curves and diversion loads. Pay special attention to the excess power in the system and how that can be put to value-added use. (Include the electronic HOMER file in your submission, but limit the printed report to HOMER output from the proposed system.)
- ☐ Show how the economies of scale are affected by using different types and quantities of turbines. How do these options vary the overall system cost, the cost per installed kilowatt and unusable excess power? This analysis should reflect that offsetting electrical load has greater economic benefit than offsetting heat loads due to the varying efficiencies of diesel generators versus oil-fired boilers.

- If the project involves, or could involve, the intertie of two or more communities, analysis becomes more complex to determine where diesel and wind power generation are located relative to community loads. Cost and efficiency of reliable communication between the wind site and the powerhouse should be considered. Savings may be gained through consolidation of bulk fuel facilities or idling of power plants. Further, the larger load of the combined communities may allow for larger turbines with better economies of scale. These benefits should be weighed against any loss of rural employment or higher heating oil delivery costs for communities losing power plants.

Common Pitfalls

- Placing all focus of the design at the wind turbine site - Much of the needed design activity deals with integrating wind power with the existing power plant, distribution system and community heat loads.
- Not realizing that most modeling tools estimate turbine performance on the lower-48 grid where all wind power can be absorbed by the grid – Greater than 40% capacity factors aren't reasonable estimates and they degrade the impression of your report.
- Ignoring the excess kilowatt hours reported by HOMER – This number must be subtracted from your total kilowatt hours to accurately estimate diesel fuel savings. Proposed projects should find a dispatchable load that can use this excess energy. Bear in mind that the economic benefit of offsetting a heat load is less than offsetting diesel electric generation.
- Insufficient analysis of heat loads in the community. Simply placing an electric boiler on the heat recovery loop is likely the best choice if 80-percent of the BTUs being added to the HR loop are being consumed by users to offset heating oil. If only 30-percent of the HR energy is being used to offset heating oil, a different building that cannot tie into the HR loop would be the better location.
- Oversized diesel generators may negate any assumed benefits from wind power – Wind diesel systems require small, medium and large gensets so that as wind power comes online, smaller diesel generators can be selected based on which generator is currently in the optimum part of the fuel efficiency curve for the net system load. A 1MW wind system proposed in Nome resulted in no actual fuel savings under the existing diesel configuration. Adding smaller gensets to the SCADA system provided for ~ 900,000 gallons of diesel savings per year with the proposed wind turbine. Further, lowering the minimum load setting on a generator may result in sending unburned fuel up the exhaust stack.
- Small (<400kW) 1200-RPM generators do not respond quickly enough to variable wind power to maintain frequency control on the system. 1800-RPM engines in this size range have proven to be more effective in wind-diesel systems - preferably with electronic controls. Larger (500kW and up) 1200-RPM generators have not been an issue to date.
- Oversizing the proposed wind system – A 250kW wind turbine on a system with an average load of 70kW is a potential disaster. Simply adding battery storage and an inverter may sound like a trivial solution, but this has not been successfully executed in Alaska. Large turbines can trip diesel gensets offline.

- Proposing unproven wind, storage or controls technology to the Renewable Energy Fund – New technology falls under the scope of the Emerging Energy Technology Fund and should be proven out in a more accessible location than remote Alaska.
- Proposing turbines that are not certified by an independent 3rd party – Turbine manufacturers make optimistic claims on the performance of their product. AEA requires wind turbines that have been verified by a certified test facility. These turbines also need cold weather packages.
- Ignoring the O&M challenges of a wind system – Communities who have personnel that are trained on wind systems and are comfortable climbing exposed towers to perform maintenance have a better chance at meeting the output projections of your design. Major impacts to production are seen the more remote a community is if there is no local trained support.
- Building a wind-diesel project without a remote SCADA system that allows for performance data collection and offsite troubleshooting.
- Building a wind project without performing a structured wind resource analysis. Building a wind project when the wind resource analysis indicates poor wind conditions.