

CERTIFICATION TESTING RESULTS AND CONSUMER RATINGS: GROWING THE SMALL WIND MARKET

Larry Sherwood
Brent Summerville
Small Wind Certification Council
56 Clifton Country Road, Suite 202
Clifton Park, NY 12065
larry@smallwindcertification.org

Heather Rhoads-Weaver
Matt Gagne
eFormative Options, LLC
PO Box 47
Vashon, WA 98070
heather@eformativeoptions.com

ABSTRACT

The Small Wind Certification Council (SWCC) has fully certified four turbine models to the American Wind Energy Association's *Small Wind Turbine Performance and Safety Standard* (AWEA 9.1-2009). Four other turbine models have achieved milestones, including one Limited Power Performance (LPP) certification and three Conditional Temporary Certifications.

Until recently, performance specifications for distributed wind turbines were not standardized. In 2010, the SWCC began to accept applications for certification. The SWCC certifies performance and safety testing results and issues easy-to-understand labels for Rated Energy Output, Rated Power and Rated Sound Level. More than 40 wind turbine models have taken steps toward SWCC certification.

SWCC certification ratings and labels enable consumers to make more informed decisions about small and medium wind turbines, provide states and incentive programs with a means to qualify turbine models that are eligible for incentives, and pave the way toward national requirements and greater industry credibility.

1. NEED FOR CERTIFICATION

Wind turbines have great potential to serve increasing demands for distributed generation and can provide a cost-effective solution for many homes, farms, schools and other end-users. Distributed wind technology offers increased security of energy supply as well as community awareness of clean energy options.

However, in the past several obstacles hindered greater adoption of small and medium wind turbines, including:

- Performance specifications were not standardized, and manufacturer claims are optimistic and inconsistent;
- Consumers lacked user-friendly tools to compare turbines or accurately estimate energy performance;
- Consumers and agencies providing financial incentives needed greater assurance of safety, functionality, and durability to justify investments; and
- Less than half of the small wind turbine models on the market have been tested.

In the absence of a standardized certification, many incentive programs established their own definitions for distributed wind turbine ratings, which varied by as much as 40% between programs. SWCC certification, which certifies small wind turbines to the AWEA Small Wind Turbine Performance and Safety Standard, is the most effective approach to surmounting these hurdles.

The standardized certification process supplies easy-to-understand labels that allow consumers to make “apples-to-apples” comparisons of different wind turbines, and allows for states and incentive programs to have a consistent approach to qualify turbines for incentives. The Interstate Turbine Advisory Council (ITAC), an alliance of clean energy programs and utility incentive providers, now

requires full certification to be eligible for its national unified list of small and medium wind turbines that meet the performance, reliability, and warranty service expectations of incentive providers.

2. HISTORY

In 2006, a group of individuals and government entities, all with an interest in the development of a North American small wind market, recognized the need for a body that would independently verify the performance of small wind turbines. As a result, that group subsequently established the Small Wind Certification Committee Working Group, which consisted of more than 60 entities, including the major small wind turbine manufacturers, representatives from a number of US states and Canada, as well as universities and key individuals.

The Interstate Renewable Energy Council facilitated the Working Group. The following organizations funded the Working Group activities: Canadian Wind Energy Association (with funding from Natural Resources Canada), Casper College (Wyoming), Energy Trust of Oregon, Iowa Energy Center, National Renewable Energy Laboratory, Nevada State Energy Office, New York State Energy Research and Development Authority and the Wisconsin Department of Administration.

Through 2006 and 2007, the Working Group compiled a comprehensive organization plan for the Small Wind Certification Council (SWCC). This contained the market research that demonstrated the need, the mission statement, description of services to be provided, Board structure, staff and their functions, funding and marketing plans, timelines and other information.

In early 2008, SWCC moved on to the next stage of its development when it incorporated as a new non-profit organization, elected its first Board of Directors and began to hire staff. Through 2009, SWCC developed the policies and procedures that govern the certification process.

SWCC began to accept certification applications in February 2010, and issued its first full certification in November 2011. Since then, three other turbine models have achieved full certification. In June 2012, the SWCC obtained ISO Guide 65 accreditation from the American Association for Laboratory Accreditation (A2LA) to certify small wind turbines to AWEA Standard 9.1-2009. Accreditation to ISO Guide 65 ensures the universal recognition of SWCC turbine certifications worldwide, while ensuring that certification activities are conducted impartially, systematically and in a uniform manner.

In December 2012, SWCC began offering certification for medium wind turbines with swept areas larger than 200 square meters to the service of certifying Power Performance test results per IEC 61400-12-1 and Acoustic test results per IEC 61400-11. Work is underway to develop a globally accepted approach to certifying medium wind turbines. There is industry consensus that certification of these two performance tests will remain a requirement in any proposed new medium wind certification scheme. This interim step will provide consumers with some assurance of the performance of these turbines, while a global scheme for full certification is developed.

3. SMALL WIND CERTIFICATION COUNCIL

The SWCC, as an independent certification body, certifies that wind turbines meet the performance and durability requirements of the American Wind Energy Association *Small Wind Turbine Performance and Safety Standard* (AWEA 9.1-2009). This certification provides a common North American standard for reporting turbine energy and sound performance, and helps distributed wind technology gain mainstream acceptance.

SWCC issues certified turbines easy-to-understand labels for Rated Annual Energy Output, Rated Power, and Rated Sound Level. The label also confirms that the turbine design meets durability and safety requirements. SWCC's web directory includes Power Curves, Annual Energy Performance Curves and measured sound pressure levels, and other technical information for each model certified. Applicants applying for certification design and test their turbines to AWEA Standard 9.1-2009. SWCC does not conduct tests, but verifies and certifies test results submitted by testing organizations.

SWCC's mission is to develop and implement quality product certification programs for distributed wind turbines, and to promote the benefits and applications of wind technologies to the public in conjunction with renewable energy organizations, the wind industry, government agencies, and other stakeholders.

The goals of SWCC's activities include:

- Supporting the use of distributed wind turbines in North America and internationally;
- Fostering the exchange and dissemination of information concerning turbine energy and sound level performance; and
- Supporting and fostering appropriate government regulations and legislation related to wind technology issues.

3.1 SWCC Governance

SWCC is an independent non-profit organization that verifies and certifies test results and design calculations, operating with strict procedures to ensure credible, independent evaluation of wind turbines. A three-member Certification Commission makes all certification decisions. The Commissioners are qualified and independent industry experts who have filed disclosure statements to ensure that they do not have any conflicts of interest. Three of the eleven Board directors are from the industry to give input into SWCC policies and operations. SWCC Bylaws and operating procedures are designed so the Board has no involvement in individual certification decisions. The President of SWCC cannot come from the Industry Sector, and other safeguards are built into the governance rules to prevent conflicts of interest for the Industry Sector Directors.

4. AWEA STANDARD

SWCC certifies wind turbines that meet the requirements of the AWEA *Small Wind Turbine Performance and Safety Standard*. The AWEA Standard provides meaningful criteria upon which to assess the quality of the small wind turbine and to provide consumers with performance data that will help them make informed purchasing decisions.

The AWEA Standard incorporates three international standards issued by the International Electrotechnical Commission (IEC):

- IEC 61400-2 Ed. 2: *Design requirements for small wind turbines*;
- IEC 61400-11 Ed. 2: *Wind turbine generator systems – Acoustic noise measurement techniques*; and
- IEC 61400-12-1: *Wind turbines – Power performance measurements of electricity producing wind turbines*.

In addition, the AWEA Standard is similar to a standard issued by the British Wind Energy Association (BWEA) and used in the United Kingdom.

5. ELIGIBILITY FOR CERTIFICATION

Eligible turbines for certification to AWEA Standard 9.1 - 2009 are electricity-producing wind turbines with a swept area up to 200 m² (2,150 ft²). This corresponds to a rotor diameter of about 16 meters (52 feet). Depending on the exact turbine design, this maximum size is a turbine

producing about 50-65 kW. Both horizontal and vertical axis turbines are eligible to apply for certification.

Medium wind turbine certification eligibility applies to turbines with a swept area greater than 200 square meters. As a globally accepted medium wind turbine certification scheme is being developed, SWCC is offering Power Performance and Acoustic Performance certification for medium wind turbines to international standards.

SWCC certification applications may be submitted only by the holder of all ownership rights in and to the wind turbine (Manufacturer), or the manufacturer's authorized designee. If the Applicant is an authorized designee, the designee must submit written proof of authorization to seek SWCC certification from the Manufacturer. SWCC will have the sole and exclusive right to determine whether such a designee is properly authorized to seek SWCC certification.

6. TESTING

Testing a wind turbine to the requirements of the AWEA standard can be expected to take at least 6-9 months, depending on the wind regime in which the test facility is located. If the turbine design evolves as part of the field testing, testing and reporting may take as much as 12 to 18 months to complete.

Some testing organizations are accredited to ISO/IEC Standard 17025 to perform power performance, duration and acoustic testing to recognized standards and some are not. Test reports from accredited organizations, such as the National Renewable Energy Laboratory (NREL), require the minimum level of scrutiny from SWCC. Test reports from non-accredited organizations require a higher level of scrutiny to independently verify the test setup complies with the standard, the competence of the organization, and the quality of the test reports. SWCC will audit all non-accredited test organizations. SWCC's Certification Policy details the testing requirements.

In order to help streamline the certification process, SWCC has focused increased attention on field testing. Field testing performed by an accredited testing organization continues to represent a streamlined and cost effective pathway toward certification, however many of the active test sites are operated by non-accredited organizations that require an on-site evaluation by SWCC staff. SWCC has designated three testing organizations as "preferred testing organizations" that SWCC has experience working with: the AEI Regional Wind Test Center in Canyon, Texas; Windward Engineering in Spanish Fork, Utah; and the Wind Energy Institute of Canada on Prince Edward Island, Canada. On-site SWCC evaluations here are typically are

simpler and cheaper than for other non-accredited testing organizations.

The U.S. Department of Energy and the National Renewable Energy Laboratory (NREL) selected four independent testing organizations as Regional Test Centers to support with funding and technical assistance in order to expand the testing capacity in North America. Three of the Regional Test Centers are non-accredited and all operate independently of NREL.

7. CERTIFICATION

The process of completing SWCC certification depends on the quality of the test reports and level of issue resolution required. SWCC certification takes approximately 2 to 4 months once test reports and an application is received. The structural analysis of the wind turbine can be performed in parallel with the field testing however, turbine designers are encouraged to perform these calculations prior to initiating field testing for certification.

Once the Certification Commission approves certification, SWCC issues a Certificate and posts the following technical information about the turbine on SWCC's web site:

- Manufacturer/Model
- Power Form
- Rotor Diameter and Swept Area
- Cut In/Out Wind Speed
- Maximum Power, Voltage and Current
- AWEA Rated Annual Energy @ 5 m/s
- AWEA Rated Sound Level
- AWEA Rated Power @ 11 m/s
- IEC turbine class and design compliance for mean and reference wind speeds
- Duration Test compliance with IEC turbine class for mean and reference wind speeds
- Mechanical and electrical connections
- Minimum blade/tower clearance

- Maximum tower top loads
- Maximum allowable tower top deflection

While turbine applications are pending, SWCC lists the Applicant's name and turbine model, the date the applicant is under contract, the date the turbine began testing, and the date reports are submitted. Applicants can choose to have their name and model remain confidential while certification is being pursued. The website lists the following applicant milestones:

- Under Contract: Indicates that the Applicant has executed a Certification Agreement with SWCC;
- Under Test: Indicates that the wind turbine has been installed at the test site, commissioned, instrumented and is collecting data;
- Reports Submitted: Indicates that the Applicant has submitted a complete Test and Analysis Report to the SWCC with a Certification Application;
- Limited Power Performance Certification: Indicates that SWCC has granted a time-limited certification for a wind turbine that has met the power performance requirements of SWCC certification.
- Conditional Temporary Certification: Indicates that SWCC has granted a time-limited certification for a wind turbine tested and analyzed according to the IEC 61400 series of Standards or the BWEA Standard (certain requirements of the AWEA Standard have not yet been met).

8. RESULTS

SWCC has issued four full certifications and labels for turbines certified to the AWEA *Small Wind Turbine Performance and Safety Standard*. Four other turbines have achieved milestones, including the first Limited Power Performance (LPP) certification and three Conditional Temporary Certifications.

Table 1 shows the four fully-certified turbines, as well as the turbine with LPP certification. Figures 1-5 show the certified power curves for each turbine.

TABLE 1: FULLY-CERTIFIED AND LIMITED POWER PERFORMANCE CERTIFIED TURBINES

Applicant	Bergey Windpower Co.	Endurance Wind Power Inc.	Evance Wind Turbines Ltd.	Southwest Windpower	Eveready Diversified Products (Pty) Ltd.
Turbine	Excel 10	Endurance S-343	Evance R9000	Skystream 3.7	Kestrel e400nb 250
Rated Annual Energy @ 5 m/s Estimated annual energy production assuming an annual average wind speed of 5 m/s (11.2 mph), a Rayleigh wind speed distribution, sea-level air density and 100% availability. Actual production will vary depending on site conditions.	13,800 kWh	8,910 kWh	9,160 kWh	3,420 kWh	3,930 kWh
Rated Sound Level The sound level that will not be exceeded 95% of the time, assuming an annual average wind speed of 5 m/s (11.2 mph), a Rayleigh wind speed distribution, sea-level air density, 100% availability and an observer location 60 m (~ 200 ft) from the rotor center.	42.9 dB(A)	Pending full certification	45.6 dB(A)	41.2 dB(A)	55.6 dB(A)
Rated Power @ 11 m/s The wind turbine power output at 11 m/s (24.6 mph) at standard sea-level conditions.	8.9 kW	5.4 kW	4.7 kW	2.1 kW	2.5 kW
Certification Granted	11/16/2011, renewed 11/16/2012	Limited Power Performance Certification, 9/6/2012	12/18/2012	12/19/2011, renewed 12/19/2012	2/14/2013
Certification Number	SWCC-10-12	LPP-10-09	SWCC-10-27	SWCC-10-20	SWCC-10-16

9. ELECTRICAL SAFETY CERTIFICATION

Electrical testing and listing of small wind turbines for code compliance is a related piece for the permitting and inspection of small wind turbine installations. The development of the AWEA Standard and SWCC was never intended to address this need. SWCC certification is primarily a verification of durability, function, power performance, and acoustic characteristics of distributed wind turbines to provide consumers and state agencies with information that will help them make informed decisions. Code enforcing officials may still require certification from a Nationally Recognized Test Laboratory (NRTL) that ensures the electrical safety of the wind turbine and satisfies the NEC requirement for NRTL listing. This electrical safety certification is outside the scope of SWCC.

In September 2011, in cooperation with AWEA, Authorities Having Jurisdiction (AHJs), small wind turbine manufacturers and other industry stakeholders,

Underwriters Laboratories (UL) formed a Standards Technical Panel (STP) to develop a new electrical safety standard for small wind turbines. The process is now complete and ANSI/UL 6142 Ed. 1 - *Standard for Safety for Small Wind Turbine Systems* was published as an American National Standard on November 30, 2012. The 2014 National Electrical Code (NEC) will reference this new standard for small wind turbines and small wind turbine manufactures are encouraged to start working on UL6142 certification now that the standard has been adopted.

Certification to AWEA Standard 9.1-2009 is a prerequisite for UL6142 certification as stated in section 1.2: “It is intended that the electrical subassemblies that address power transfer control and protection functions evaluated per this document are to be coordinated with the mechanical and structural limitations specified in AWEA 9.1, Small Wind Turbine Performance and Safety Standard...”

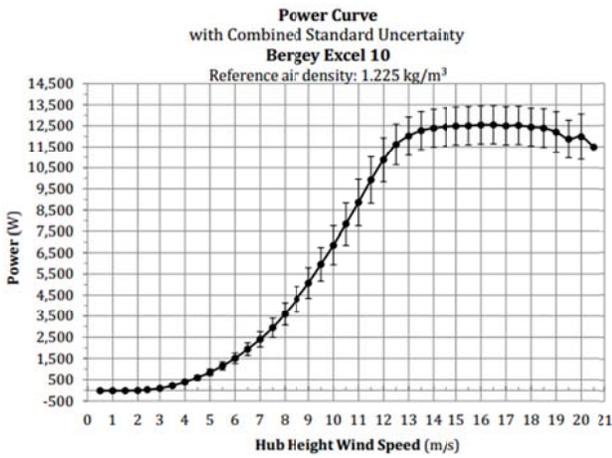


Fig. 1: Bergey Excel 10 Certified Power Curve

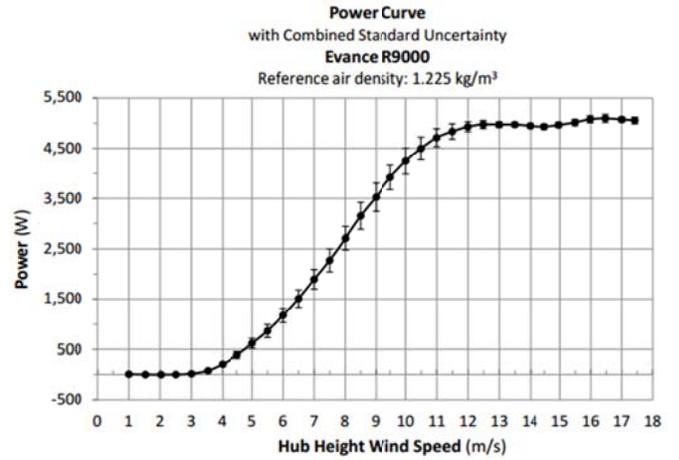


Fig. 2: Evance R9000 Certified Power Curve

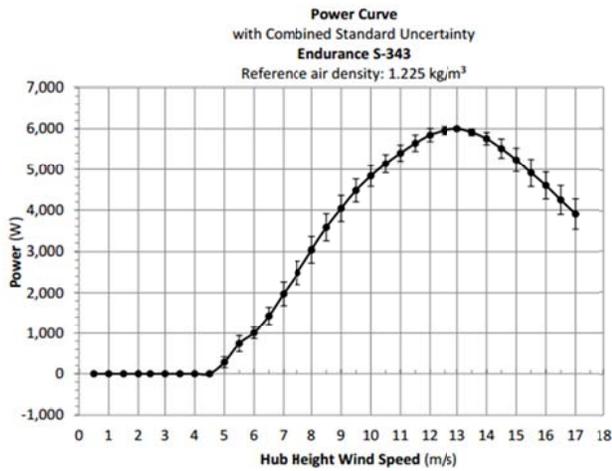


Fig. 3: Endurance S-343 Certified Power Curve

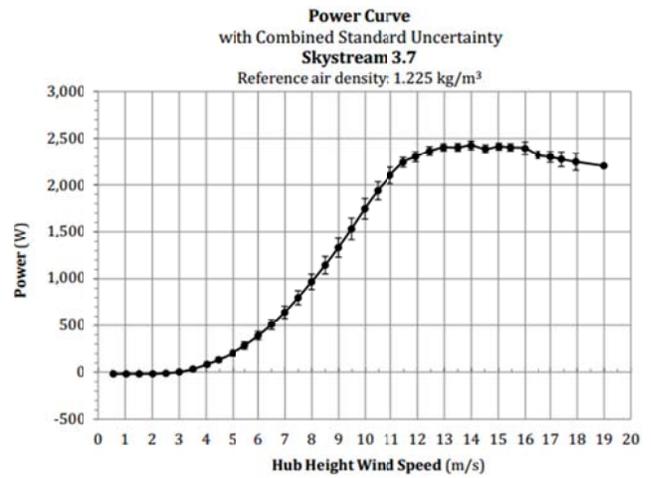


Fig. 4: Skystream 3.7 Certified Power Curve

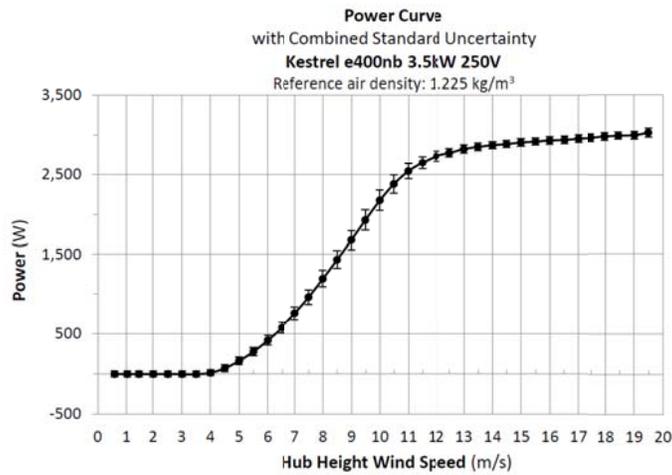


Fig. 5: Kestrel e400nb 250 Certified Power Curve

10. WHO REQUIRES SWCC CERTIFICATION

Many states and utilities provide financial incentives for the installation of distributed wind turbines. A current listing of such incentives can be found in the Database of State Incentives for Renewables and Efficiency (DSIRE) (www.dsireusa.org). Many incentive managers have been eager to incorporate SWCC certification requirements into their programs, noting that improving the reliability of performance estimates is a significant step towards increasing customer adoption of wind technology.

The Interstate Turbine Advisory Council (ITAC), an alliance of clean energy programs and utility incentive providers, now requires full certification to be eligible for its national unified list of small and medium wind turbines that meet the performance, reliability, acoustic and warranty service expectations of incentive providers. Currently, seven ITAC-member programs participate in ITAC: California Energy Commission (CEC); California Public Utilities Commission; Energy Trust of Oregon; Massachusetts Clean Energy Center (MassCEC); New Jersey's Clean Energy Programs; New York State Energy Research & Development Authority (NYSERDA); NV Energy. Two other programs contribute to ITAC: Minnesota Department of Commerce Division of Energy Resources and Wisconsin's Focus on Energy.

More states and utilities are sending a clear signal to small wind turbine applicants on requirements for certification. In addition to the ITAC participating agencies, the Vermont Clean Energy Development Fund and the Maryland Energy Administration Windswept Grant Program also require either SWCC certification or previous program qualification for incentive eligibility. Several other agencies, such as the Colorado Energy Office, Efficiency Maine, the Iowa Energy Center, the Illinois Department of Commerce and Economic Opportunity, and the U.S. Department of Agriculture are expected to implement wind turbine certification requirements in the near future. An SWCC survey of state and utility incentive program managers revealed that certification could help expand their programs for small wind turbines. More than half of the states, utilities, and funding agencies with existing requirements for small wind turbines who responded to the SWCC survey indicated that they expect to use certification to supplement or replace their existing procedures.

For wind turbines with a swept area greater than 200 square meters, ITAC, the Energy Trust and other agencies require certification to applicable sections of IEC 61400-1 from an accredited, independent certification body or a full technical review including documentation of performance, safety and durability, including reported production demonstrating reliable operation (12 months of wind speed data coupled

with monthly energy production information maintaining operational availability of at least 90%) of that model of equipment at retail installation in North America with annual average wind speeds of at least 12 mph at hub height and an owner/operator who is available for interview.

11. FEDERAL TAX CREDIT

Certification is not currently required for small wind turbine owners to receive the federal Investment Tax Credit. This could change in the future. The current eligibility requirements are linked at [http://en.openei.org/wiki/Residential_Renewable_Energy_Tax_Credit_\(Federal\)](http://en.openei.org/wiki/Residential_Renewable_Energy_Tax_Credit_(Federal)).

The Mid-Size and Federal Policy Committees of the Distributed Wind Energy Association (DWEA) have developed detailed recommendations for the Internal Revenue Service and have contacted members of the US Congress encouraging the adoption of mandatory certification requirements to be eligible for the 30 percent federal Investment Tax Credit.

12. RECIPROCITY WITH OTHER CERTIFICATION SCHEMES

In addition to SWCC certification, manufacturers can pursue Certification to IEC Standards and/or Certification to the BWEA Standard for the Microgeneration Certification Scheme (MCS) in the United Kingdom.

There are a number of certification bodies that offer Type Certification to the IEC 61400 series of standards for wind turbines. Type Certification is currently performed in accordance with IEC 61400-22.

SWCC grants Conditional Temporary Certification to turbines that have been tested and analyzed pursuant to the IEC 61400 series of Standards or the BWEA Standard (which are similar to the AWEA Standard); however, certain requirements of the AWEA Standard have not been met. If Conditional Certification is granted, SWCC requires that the Applicant satisfy identified conditions or additional requirements within the 12 month Conditional Certification period in order for the wind turbine to be eligible for full SWCC Certification.

The SWCC certification scheme has some similarities but also important differences from the UK's Microgeneration Certification Scheme (MCS). Both involve independent, third-party certification which assures the quality of wind turbines as well as provides government agencies with reliable technical information so they can intelligently craft consumer renewable energy programs.

Under MCS, manufacturers must 1) conform to the BWEA *Small Wind Turbine Performance and Safety Standard* and 2) receive verification that the company's quality management system is in accordance with the Factory Production Control requirements. SWCC certifies to the Standard, but does not verify the company's quality management system.

While the core of the AWEA and BWEA Standards are harmonized, there are differences to consider. For example, because grid requirements differ in the UK and North America, the two configurations may exhibit operational differences that require additional evaluation or testing. In addition, since the acoustic requirements differ between the Standards, MCS acoustic data must be reanalyzed before a turbine can be certified to the AWEA Standard.

Through active ongoing participation in technical committees for the AWEA Standard, the BWEA Standard and the IEC Standards, SWCC is playing a key role in helping to update and achieve international harmonization of standards, testing and certification. SWCC is working diligently with other small wind certification programs in Europe, Asia and the Americas to minimize the differences between country-specific requirements in order to address a well-recognized market barrier.

In June 2012, the SWCC obtained ISO Guide 65 accreditation from the American Association for Laboratory Accreditation (A2LA) to certify wind turbines to AWEA Standard 9.1-2009. Accreditation to ISO Guide 65 ensures the universal recognition of SWCC turbine certifications worldwide, while ensuring that certification activities are conducted impartially, systematically and in a uniform manner. SWCC accreditation as an independent certification body is a crucial step in enabling reciprocity between North American the rest of the world.

13. IMPORTANCE OF CERTIFICATION

The urgent need for distributed wind certification has never been greater. Funding agencies and utilities are asking for greater assurance of safety, functionality, and durability. This lack of performance assurance has in some cases resulted in the lack of support for consumer wind financial incentives. In the past several years, several programs, including in California and New Jersey, suspended their incentive programs due to performance issues of awarded projects. These suspensions have caused hardships for legitimate manufacturers. Certified performance ratings can alleviate the problem by providing the assurance that funding agencies need.

SWCC benefits for suppliers include:

- Increased mainstream credibility;
- Conformity with performance and safety standards; and
- Published power curves and sound levels.

SWCC benefits for consumers include:

- Comparison shopping;
- Consistent ratings on easy-to-understand labels; and
- Established pathways to qualify for incentives.

With SWCC labels, consumers can compare products, and funding agencies and utilities will gain greater confidence that distributed turbines installed with public assistance have been tested for safety, function, performance and durability and meet requirements of consensus standards. Certification helps prevent unethical marketing and false claims, ensuring consumer protection and industry credibility.

14. REFERENCES

(1) *Small Wind Turbine Performance and Safety Standard* (AWEA Standard 9.1 – 2009), American Wind Energy Association, 2009. <http://www.smallwindcertification.org/for-applicants/awea-standard/>

(2) BWEA *Small Wind Turbine Performance and Safety Standard*, British Wind Energy Association, 2008. <http://www.renewableuk.com/en/utilities/document-summary.cfm?docid=97D39F8A-0760-45C5-8D9D6B8E7F2302FD>

(3) IEC 61400 Series Wind Turbine Standards. <http://webstore.iec.ch/webstore/webstore.nsf/mysearchajax?Openform&key=61400&sorting=&start=1&onglet=1>

(4) Microgeneration Certification Scheme Product Listing. <http://www.microgenerationcertification.org/mcs-consumer/product-search.php>

(5) *Small Wind Turbine Certification Policy*. Small Wind Certification Council, 2013. <http://www.smallwindcertification.org/wp-content/new-uploads/2013/02/SWCC1Small-Wind-Turbine-Certification-Policy-01Feb2013.pdf>