Small Wind Turbine Electrical System Considerations

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The acceptability of small wind turbine installations is typically governed by the authorities having jurisdiction (AHJ). These would typically be local or provincial electrical inspection authorities.

The basis for acceptance has most recently been derived from application of the appropriate sections of the respective National Electrical Codes – NEC and CEC.

Certification by Nationally Recognized Testing Laboratory (NRTL) for US and/or Certification Organization (CO) in Canada indicates compliance.
Background

Lack of specific guidance for small wind turbine generator installations is driving the need for standardization.

Inspection authorities basis of acceptance includes:

• Interpretations of existing sections of Codes
• Non-mandatory practices developed by trade organizations
Internationally IEC 61400-2 references IEC 60204-1 for electrical safety.

CAN/CSA C61400-2 retains reference to IEC 60204-1 and provides national deviations for references to the Canadian Electrical Code and selected Part II standards.
An outline of investigation was published in 2009 for Wind Turbine Electrical Systems (UL Subject 6140)

Very general in nature and did not specifically address issues for small wind
More recently


The 2012 Edition of the Canadian Electrical Code added Section 64, which includes Rules 64-300 through 64-320 for Small Wind turbine installation.

Highlights of these requirements will be provided later in the presentation.
Codes vs. Standards

Until recently, the Electrical Codes have been the primary guidance for installers and manufacturers for electrical construction.

The need for product standards has been identified in order to assist manufacturers in their small wind turbine electrical system designs so that they meet the requirements of the National Electrical Codes.
New Product Standards

US Standard for Small Wind Turbine Systems in development - UL 6142

Canadian Standard also in development: Wind Turbine Electrical Qualification Standard for Large and Small Wind Turbines - CAN/CSA C22.2 No. 272

Deal with product specific issues not covered in the electrical codes
Establish consistent rules for the mitigation of the following hazards:

- Electric shock
- Fire
- Energy
- Mechanical as related to moving parts and control and protection systems

Consensus process governed by ANSI rules
# Role of Wind Turbine Electrical System Standards

- Supports Electrical Code compliance
- Expedites acceptance of installations
- Benefits the industry as a whole through due diligence
Highlights of the new electrical standards

More specific requirements for Small Wind Turbine Components, including the appropriate certifications.

The UL and CSA Standards are going to identify component standards and critical aspects of evaluation for components such as:

- Generators
- Wiring devices
- Control devices
- Slip ring
- Control panels
- Loads
- Disconnects
- E-Stop Switch
- Inverter/Charge controller

- Gearbox
- Control gear
- Hydraulic systems
- Batteries and other energy storage
- Lightning protection
- Surge suppressors
The electrical standards UL 6142 and C22.2 No 272 will also provide minimum constructional requirements addressing the following:

- Electrical Spacings
- Grounding
- Safety Related control systems
- Disconnecting means including routine and emergency stop
- Manual Shutdown
- Utility interaction
- Sizing and protection of conductors and components
- Environmental ratings for components
- Markings
The National Electrical Code and Canadian Electrical Code requirements are consistent with the requirements in the previous slide.
Highlights of Article 694, including proposed changes for 2014(N):
• Scope is for 1 or more wind turbine generators up to a total of 100 kW output
• Voltage to ground and equipment accessibility limitations for 1 and 2 family dwellings
• Circuit sizing criteria provided
• Overcurrent protection rules will generally follow Article 240
• Disconnecting means are required for all current carrying conductors except those used for turbine speed control
• Wiring methods in accordance with Code
Highlights of Article 694, including proposed changes for 2014(N):

- Markings requirements
- Article 705 to apply to grid interactive installations
- Coverage for storage batteries and charge controllers. Note: Storage batteries will be moved to a new section for 2014 code
- Systems over 600 volts are to comply with Article 490
- GFCI required for maintenance receptacles (N).
- Equipment, subassemblies and components are to be listed or recognized for use in wind turbine generators(N)
Highlights of Article 694, including proposed changes for 2014(N):

- Metallic and non-metallic poles may be considered to be raceways when evaluated as part of the overall installation(N)
- Output voltage max 600 volts for 1 & 2 family units(N)
- Readily accessible manual shutdown capable of placing the turbine in a parked state and deenergizing the output is required(N)
- Clarification on allowable conductor and cable types and grounding rules(N)
Highlights of Section 64-300 of CEC

- Minimum marking requirements
- Maximum 600 volts for single family dwellings
- Accessibility limitations for equipment exceeding 150 volts to ground for single family dwellings
- Conductors rated min 90°C, 125% ampacity
- Wiring methods are to follow the Rules of Part 1 in general. Poles and towers may be used as raceway or support.
- Overcurrent protection
Highlights of Section 64-300 of CEC

- Disconnecting means required for each load circuit unless employed for rotor speed control.
- Section 10 to be followed for grounding and bonding. Ground detection is required for ungrounded AC systems.
- Lightning protection to follow Section 10 if provided.
- Supply authority system is not to be used as diversion load.
- Surge protective devices are required between system and premises.
- Instructions via plaque required for disabling turbine.
Typical submittal should include:

- Complete bill of materials
- Electrical schematics including one line and cabling diagrams
- Complete ratings information
- Component cut sheets to include complete descriptions and functionalities and certification information
- Installation instructions
- Plan and elevation views for typical installation
- Design or type Certificates per AWEA 9.1 and/or IEC 61400-2
Electrical System Certification Process Steps:

- Preliminary design review based on submittals and instructions
- Compliance plan based on submittals
- Physical review of samples as typically presented to the installation site
- Component evaluations
- Review of system integration and testing if required at the system level
- Address non-compliances (if any)
- Issue certification
Valued Quality. Delivered.