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SUBJECT 6140

OUTLINE OF INVESTIGATION
FOR
WIND TURBINE GENERATING SYSTEMS

Issue No. 1

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Summary of Topics

This is the first issue of the Subject 6140 Outline of Investigation for Wind Turbine Generating Systems.

The UL Foreword is no longer located within the UL Standard. For information concerning the use and application of the requirements contained in this Standard, the current version of the UL Foreword is located on ULStandardsInfoNet at: <http://ulstandardsinfo.net/ulforeword.html>

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INTRODUCTION

1 Scope

1.1 This Outline of Investigation covers Wind Turbine Generating Systems (WTGS) and electrical subassemblies. These units are intended for use in stand-alone (not grid-connected) or utility interactive applications. Utility-interactive WTGS are operated in parallel with an electric power system (EPS) to supply power to common loads.

1.2 The WTGS power, control and protection systems are evaluated only to the extent that they function within the manufacturer's specified limits and response times. These control and protection functions are evaluated with respect to risk of electric shock and fire. 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 evaluation of the WTGS in accordance with the IEC 61400 series documents or Germanischer Lloyd WindEnergie GMBH: Guideline for the Certification of Wind Turbines documents.

1.3 This Outline of Investigation does not cover:

- a) WTGS intended for off-shore installation.
- b) Mechanical or structural integrity of the WTGS or subassemblies.
- c) Coordination of electrical and mechanical systems to maintain the WTGS within its safe mechanical and structural limits.
- d) Mechanical loading of ladders, scaffolding, personnel tie offs, or other personnel load bearing functional parts.

1.4 The products, systems, and subassemblies covered by these requirements are intended to be installed in accordance with the National Electrical Code, ANSI/NFPA 70.

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this Outline shall comply with the requirements for that component. See Appendix A for a list of standards covering components used in the products covered by this Outline. See also Section 3, Special Components and Subassemblies of WTGS.

2.1.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this Outline, or
- b) Is superseded by a requirement in this Outline.

2.1.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.1.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

2.1.5 Components and subassemblies of the overall WTGS shall be evaluated and found suitable for operation over the normal range of electrical and environmental conditions as specified by the WTGS manufacturer.

2.2 Units of Measurement

2.2.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

2.3 Undated References

2.3.1 Any undated reference to a code or standard appearing in the requirements of this Outline of Investigation shall be interpreted as referring to the latest edition of that code or standard.

3 Special Components and Subassemblies of WTGS

3.1 Wiring

3.1.1 Internal wiring shall comply with the Standard for Industrial Control Equipment, UL 508, in addition to the requirements in this section.

3.1.2 Wiring that is subject to movement, flexing, or twisting during operation of the wind turbine shall be investigated for suitability in the conditions of use and rated life or cycle time.

3.1.3 All wiring within a WTGS that is large enough for service personnel to enter the structure shall be rated for tray cable usage. The following meet the intent of the requirement:

- a) Multiconductor cable complying with the Outline of Investigation for Flexible Motor Supply Cable and Wind Turbine Tray Cable, Subject 2277, and marked for Wind Turbine usage.
- b) Power-limited circuit cabling complying with the Standard for Power-Limited Circuit Cables, UL 13, suitable for Tray Cable usage (Types CMG, CM, CL2, CL3, PLTC, CMR, CL2R, CL3R, CMP, CL2P, CL3P).
- c) Optical fiber circuits complying with the Standard for Optical Fiber Cable, UL 1651.
- d) Power cabling complying with the Standard for Thermoplastic-Insulated Wires and Cables, UL 83, or the Standard for Thermoset-Insulated Wires and Cables, UL 44, and additionally marked for Cable Tray usage ("CT", "For Cable Tray Use", "For CT Use", or "For Use in Cable Trays") or marked FT4.

Exception: Wiring within a component need only meet the requirements for the component.

Note: For Canada, an FT4 rating is required per the Canadian Electrical Code.

3.1.4 Wiring within a rotating hub shall be additionally protected from mechanical damage. Such protection may be provided by enclosures or conduit complying with the Standard for Metallic Outlet Boxes, UL 514A, and/or the Standard for Conduit, Tubing, and Cable Fittings, UL 514B, mechanical shielding, or the equivalent.

3.1.5 Wiring subjected to exposure to water or oil during normal or abnormal conditions such as a gasket or seal leak shall be suitably rated for the condition.

3.1.6 Wiring subjected to UV exposure shall be rated for exposure to sunlight.

3.2 Cable drip loop

3.2.1 If operation of the wind turbine may result in twisting of flexible cables, such as the connecting cables between rotating parts (nacelle) and parts of the fixed structure (tower or foundation), the operational conditions of use shall not cause damage to the conductors or their insulation. The evaluation shall address service life, electrical and environmental operating conditions of the subassembly.

3.2.2 Controls that prevent damage to conductors or their insulation including rotational limits shall be considered part of the Safety Related Controls System evaluation of this document. The Control shall be designed such that resetting to the neutral position is possible. See Section 9, Safety Related Controls System (SRCS).

3.3 Bus bars

3.3.1 Sections of bus shall be suitably attached to the tower or to components of the tower intended to support the bus. The compliance of the attachment method shall be determined by subjecting a representative bus to Impact, Static Load, and Flexing tests.

3.3.2 Bus shall be guarded or insulated to prevent unintentional contact in accordance with the following:

- a) Bus shall be metal enclosed at each work platform for a minimum of 8 feet above each platform.
- b) In areas other than work platforms, bus operating at 2500 V or more shall be metal enclosed.
- c) In areas other than work platforms, bus operating at less than 2500 V shall be metal enclosed, enclosed in a non-metallic enclosure complying with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, or the conductors shall be protected by insulation and jacket that would be required of comparable tray cables specified by the Outline for Flexible Motor Supply Cable and Wind Turbine Tray Cable, Subject 2277, the Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members, UL 1277, and the Standard for Thermoplastic-Insulated Wires and Cables, UL 83.

3.3.3 Where cables are connected to bus assemblies, suitable wiring terminals shall be provided. Where the anticipated movement of the tower assembly causes movement of the cable or bus assembly, strain relief shall be provided to prevent movement of the connection.