

# Design Verification

- Did you design it right?

- Design inputs: specifications, regulatory requirements, standards compliance, etc.
- Verification outputs: pass/fail for each input.
- Verification methods: inspection, analysis, testing.
- Verification plan and procedure: planning is important. Plan early and make best testing procedure.

ECE3031

# Standards and Codes - An Introduction

## What are standards?

- A published document, established by consensus and approved by a recognized body, that sets out specifications and procedures to ensure that a material, product, method or services meets its purpose and consistently performs to its intended use.

ECE3031

## Some Standard Marks



ECE3031



ECE3031

Three-phase IGBT inverter (provided by UNB) and wind turbine, installed at Cape Jourmain, NB. Under NB Power's net-metering program



ECE3031

## Codes & Distributed Standards Enforced in NB For Generation Systems (Under Net-Metering Program)

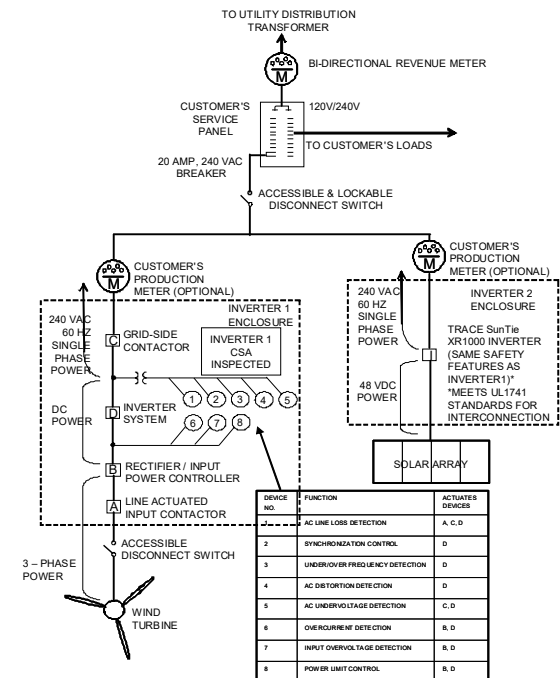
- Installation – CSA Standard C22.1-06 Canadian Electrical Code Part I
- Equipment – Certified to Canadian Standards
- Permits
  - Wiring Permits must be obtained before the electrical construction begins.
  - Detailed Plan of the installation shall be submitted for review.
  - A Wiring Permit cannot be issued without a Building Permit.

ECE3031

## Equipment - Certified to Canadian Standards by one of the following:

- Canadian Gas Association (CGA),
- Canadian Standards Association (CSA),
- Electrical Safety Authority (ESA)
- Entela Inc. (entela),
- ETL Testing Laboratories Inc. (ETL),
- FM Approvals (FM)
- Met Laboratories (MET),
- Omni-Test Laboratories Inc. (OMNI),
- QPS Evaluation Services (QPS),
- Quality Auditing Institute (QAI),
- TUV Rheinland of North America Inc. (TUV),
- TUV America Product Services Division (TUV-PS),
- Underwriter's Laboratories Inc (cUL),
- Underwriter's Laboratories of Canada (ULC),
- Warnock Hersey Professional Services Limited (WHPS),
- Field approval to requirements of the Model Code for the Field Evaluation of Electrical Equipment, CSA Special Publication SPE- 1000-99.

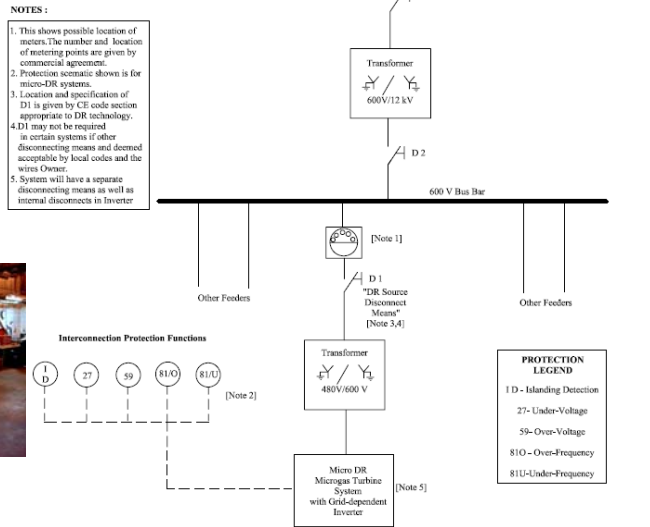
ECE3031



ECE3031

## Single-Line Diagram of a 100kW Microturbine System as a DG

TA100 CHP Microturbine System by Elliott Energy System, USA



ECE3031

## Example product: - Wind/solar utility-interactive inverter

Model No.:	112-60	This Inverter is in compliance with UL 1741 and CSA C22.2 No.107.1	
Serial No.:	1105001		
Output: 1-Phase, AC, 60Hz			
Operating voltage range	211-250 V(rms)	Input 1: 3-Phase, AC, Wind Generator	
Operating frequency range	59.5-60.5 Hz		
Nominal output voltage	240 V(rms)	Generator operating voltage	100-320 V(rms)
Nominal output frequency	60 Hz	Max. AC input current	33 A(rms)
Max. utility feed back current	56 A(rms)	Input 2: DC, PV Array	
Max. continuous output current	50 A(rms)	Nominal PV input voltage	192 Vdc
Max. continuous output power	12 kW	PV input voltage range	170-340 Vdc
Max. output fault current	56 A(rms)	Max. PV input current	9 A
Output power factor	Unity	Max. PV short circuit current	9.5 A
Max. operating ambient temperature:	40 °C		

ECE3031

## Example product: - Wind/solar utility-interactive inverter

- UL 1741:
- Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources
- C22.2 No. 107.1:
- General Use Power Supplies
- IEEE 1547:
- Standard for Interconnecting Distributed Resources with Electric Power Systems



ECE3031

## What Are Standards Good for?

- Standards solve issues ranging from product compatibility to consumer safety and health concerns.
- Standards simplify product development and reduce non-value-adding costs.
- Standards increase user's ability to compare competing products.
- Standards are the fundamental building blocks for international trade.

ECE3031

## Brief Description of Standards

- Many of Canada's standards are developed by committees, comprised of specialists, consumers and users of technology following a prescribed consensus based multi-stakeholder process.
- There are three broad types of standards: product design, product performance, and process (or management).
- Design standards identify specific design or technical characteristics of a product (e.g., seat belts, VCRs, electrical sockets, paper sizes, baby walkers, IEEE Std.11-1980 Standard for rotating electric machinery for rail and road vehicles).
- Performance standards indicate minimum standards that a product's characteristics must meet based on tests that simulate the performance of that product under actual service conditions (e.g., software/computer compatibility, hockey helmet durability, children's nightwear flammability, IEEE1547).
- Management or process standards set out standards for processes such as driving on the right side of road, test methods for flammability of textiles, quality management (e.g., ISO 9000) and environment management (e.g., ISO 14000) processes, food packaging, and advertisement approvals.

ECE3031

## Standards Resources

- More information about standards can be found in the following standards dedicated sites. The list below is not necessarily a comprehensive list.
  - World Standards Services Network (<http://www.wssn.net>)
  - World Trade Organization (<http://www.wto.org>)
  - Standards Engineering Society (<http://www.ses-standards.org>)
  - Industry Cooperation on Standards and Conformity Assessment (<http://www.icsca.org.au>)
  - International Federation of Standards Users (<http://www.ifan-online.org>)
  - Standards Council of Canada ([www.scc.ca](http://www.scc.ca))
  - Canadian Standards Association ([www.csa.ca](http://www.csa.ca))

ECE3031

## National Standards System

- National Standards System (NSS) is the Canadian framework within which voluntary standardization practices are developed and monitored.
- NSS was established over 30 years ago, comprising the Standards Council of Canada, the accredited Canadian standards-writing certification and testing organizations, and the Canadian national committees for international standardization
- Visions and objectives for NSS:
  - Influence global markets
  - Improve access to existing and new markets
  - Offer a competitive advantage for Canadians
  - Meet the needs of an evolving regulatory and policy environment
  - Represent the broad range of stakeholders
  - Communicate effectively the role and benefits of standards and conformity assessment

ECE3031

## Standards Writing Organizations

- Some of the participants in standards writing/developing activities (in the world) are:
  - Standards Council of Canada (SCC)
  - Canadian Standards Association (CSA)
  - Underwriters' Laboratories of Canada (ULC)
  - American National Standards Institute (ANSI)
  - Institute of Electrical and Electronics Engineers (IEEE)
  - International Electrotechnical Commission (IEC)
  - National Electrical Manufacturers Association (NEMA)
  - American Society for Testing and Materials (ASTM)
  - American Society of Heating, Refrigerating and Air- Conditioning Engineers (ASHRAE)
  - International Organization for Standardization (ISO)
  - International Code Council (ICC)

ECE3031

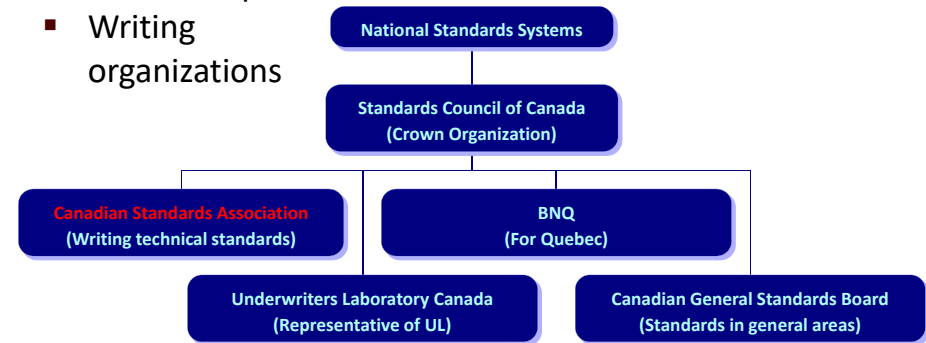
## SCC and Its Mandate

- The Standards Council of Canada (SCC) is a crown corporation created by an Act of Parliament in 1970 to foster and promote voluntary standardization in Canada. It is independent of government in its policies and operations.
- Standard Council of Canada:
  - Helps Canadians in general, obtain the best possible advantage from the use of standards in their domestic and international affairs.
  - Serves as the government's focal point for voluntary standardization.
  - Represents Canada in international standardization activities.
  - Sets out policies and procedures for development of National Standards of Canada
  - Accredits standards writing organizations, testing organizations, and registration organizations.
  - Promotes and supports the principle of recognition of accreditation as a means of decreasing the number of multiple assessments and audits.

ECE3031

## Standards in Canada

- Framework
- Crown Corp
- Writing organizations



ECE3031

## CSA - Role and Mandate

- The Canadian Standards Association is a not-for-profit membership-based association serving business, industry, government and consumers in Canada and the global marketplace.
- CSA develops standards for:
  - Public safety and health (e.g., guideline on office ergonomics): Canadian Electric Code
  - Advancing the quality of life (e.g., oil and gas pipeline systems)
  - Preserving the environment (e.g., chain of custody for forest products)
  - Facilitating trade (e.g., information technology standards)

ECE3031

## UL

- Underwriters Laboratories Inc. (UL) is an independent, not-for-profit product-safety testing and certification organization in the United States.
  - UL was founded in 1894 in the United States. UL has been active in product-safety testing and certification.
  - UL offers services to companies achieve global acceptance, whether for an electrical device, a programmable system, or an organization's quality process.
  - UL has become one of the most recognized, reputable conformity assessment providers in the world.
  - ULC is Canadian branch of Underwriters Laboratories.

ECE3031

## ANSI

- The American National Standards Institute (ANSI) is a private, non-profit organization that administers and coordinates the U.S. voluntary standardization and conformity assessment system.
- ANSI's mission is:
  - To facilitate the formation of standards in the U.S.
  - To promote the use of U.S. standards internationally.
  - To advocate U.S. policy and technical positions in international and regional standards organizations.
  - To encourage adoption of international standards as national standards where these meet the needs of the user community.

ECE3031

## IEEE - Standards Association

- The Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA) is the leading developer of global industry standards in a broad-range of industries, including:
  - Power and energy
  - Information technology
  - Telecommunications
  - Transportation
  - Medical and healthcare
  - New and emerging technology, such as nanotechnology and information assurance

ECE3031

## Product Safety

- Product Safety Standards are regulations made to prevent or reduce the risk of injury to users of products.
- In Canada, it is Healthy Environments and Consumer Safety (HECS) branch of Ministry of Health who is responsible for ensuring Canadians that the products they use are safe.

ECE3031

## HECS' Mission

- HECS' Mission:
  - To help Canadians to maintain and improve their health by promoting healthy and safe living, working and recreational environments and by reducing the harm caused by tobacco, alcohol, controlled substances, environmental contaminants, and unsafe consumer and industrial products.
- HECS' activities are divided into 5 programme areas:
  - Drug strategy and controlled substances
  - Tobacco control
  - Product safety
  - Workplace health and public safety
  - Safe environments

ECE3031

## Product Safety Programme

- The Product Safety Programme (PSP) (Health Canada's Healthy Environments and Consumer Safety branch) assists in the protection of Canadians by researching, assessing and collaborating in the management of the health and safety hazards associated with:
  - Consumer products;
  - Cosmetics;
  - Workplace chemicals;
  - New chemical substances;
  - Products of biotechnology;
  - Radiation-emitting devices;
  - Environmental notice;
  - Solar UV radiation.

ECE3031

## Common Reasons for Failures in Engineering Design

- Incorrect or overextended assumptions
- Poor understanding of the problem to be solved
- Incorrect design specifications
- Faulty manufacturing and assembly
- Errors in design calculations
- Incomplete experimentation and inadequate data collection
- Errors in drawings
- Faulty reasoning from good assumptions
- Bugs/errors in software

ECE3031

## CSA C22.2 No. 223-M91-CAN/CSA Power Supplies with Extra-Low-Voltage Class 2 Outputs

- Scope: This Standard applies to
  - (a) power supplies including transformer units of both the direct plug-in and cord-connected types that utilize a step-down, isolating transformer of the extra-low-voltage secondary type and that may incorporate rectifiers and other components to provide an ac or dc output; and
  - (b) battery chargers for rechargeable batteries.
- This Standard applies to power supplies intended for use indoors in nonhazardous locations in accordance with the Rules of the Canadian Electrical Code, Part I, when connected to a nominal system voltage of 120 V or 240 V supply and having an output conforming to the requirements for an extra-low-voltage Class 2 circuit.
- This Standard applies to power supplies intended to supply extra-low voltage for the operation of products such as household electronic equipment, telephone equipment, communications equipment, and motor-operated equipment.
- This Standard does not include requirements for batteries other than that they must be suitable for recharging.
- This Standard does not apply to automotive or nonautomotive battery chargers that do not have an extra-low-voltage Class 2 output, or transformerless, non-isolated battery chargers for charging special purpose battery packs, as covered by CSA Standard CAN/CSA-C22.2 No. 107.2, Battery Chargers.

ECE3031

## UL 1310 Standard for Class 2 Power Units

- Scope: indoor and outdoor use Class 2 power supplies and battery chargers.
- Power level: Class 2 in accordance with the National Electrical Code, ANSI/NFPA 70.
- Output: < 42.4V peak AC; < 60V DC.
- This Standard applies to:
  - (a) Portable and semipermanent mounted direct plug-in units provided with 15 A blade configurations for use on nominal 120 or 240 V alternating current branch circuits with a maximum potential of 150 V to ground; and
  - (b) Cord- and plug-connected units provided with a 15 or 20 A attachment plug configuration for use on nominal 120 or 240 V alternating current branch circuits with a maximum potential of 150 V to ground; and
  - (c) Units permanently connected to the input supply for use on nominal 600 V or less alternating or direct current branch circuit.
- Does it apply to our solar-powered battery charger?

ECE3031