Do professional engineers know the *Electrical Safety Code*?

By Peter Marcucci, P.Eng.

Over 60 per cent of electrical plans submitted to the Electrical Safety Authority (ESA) do not meet the requirements of the *Electrical Safety Code*. Plans prepared and submitted by professional engineers for regulatory approval frequently contain errors and deficiencies associated with cable sizing, overcurrent protection and ground-fault protection. Are engineers making reasonable provision for the safeguarding of life, health or property?

Recent issues of *Engineering Dimensions* have highlighted the debate that rages on over the *Building Code Statute Law Amendment Act* and the requirement that engineers demonstrate a minimum understanding of the *Ontario Building Code* (OBC).

However, in addition to the OBC, several other Ontario acts and regulations require plans to be submitted to regulatory authorities for review or approval. Included are plans for boilers and pressure vessels, amusement devices, elevators and electrical installations.

In the case of electrical installations, plans are submitted to ESA, a not-for-profit corporation with regulatory responsibility for electrical safety in Ontario. When Ontario Hydro was restructured into a number of separate companies in 1999, ESA assumed responsibility for the electrical safety activities previously handled by Ontario Hydro's electrical inspection department. The *Safety and Consumer Statutes Administration Act* (SCSAA) and an administrative agreement with the Ministry of Consumer and Business Services establish the legal framework for ESA's operation as an administrative authority. In addition to the SCSAA, ESA is designated by Ontario Regulation 89/99 as being responsible for the electrical safety requirements of the *Electricity Act, 1998* (Section 113) and the regulations made thereunder. Ontario Regulation 164/99, as amended, adopts, by reference, the *Canadian Electrical Code* (CEC), together with specific Ontario amendments, and is referred to as the *Ontario Electrical Safety Code* (OESC).

The OESC, with some exemptions, establishes the administrative and technical requirements that apply to electrical installations and equipment in all types of buildings and associated structures in Ontario. These administrative requirements include the need to file an application for inspection and to have electrical installations inspected. They also include requirements for authorizing connections, maintaining records of electrical work, reporting serious electrical incidents, approving electrical equipment, and submitting plans and specifications.

Submitting electrical plans and specifications

Rule 2-010 of the OESC deals with plans and specifications. For certain types of electrical installations, Rule 2-010 (1) prohibits the commencement of work on an electrical installation until the plans have been reviewed and approved by the ESA (unless a deviation to this requirement is granted).

Further, Rule 2-010 (2) of the OESC requires the plan's author or firm to submit the plans. Rule 2-010 (2) was introduced in 2002. Prior to that, the contractor was responsible for obtaining approval of electrical plans.

Are engineers required to submit electrical plans?

Since 2002, most engineers have been submitting electrical plans directly (as required by Rule 2-010) rather than having clients or contractors do so. However, some engineers or engineering firms have questioned this requirement. PEO has confirmed that preparing electrical plans and specifications falls within the definition of professional engineering under the *Professional Engineers Act* (PEA) and the scope of practice of a professional engineer. Subject to any exceptions provided for in the PEA, this requires the plans to be prepared by, or under the supervision of, a professional engineer.

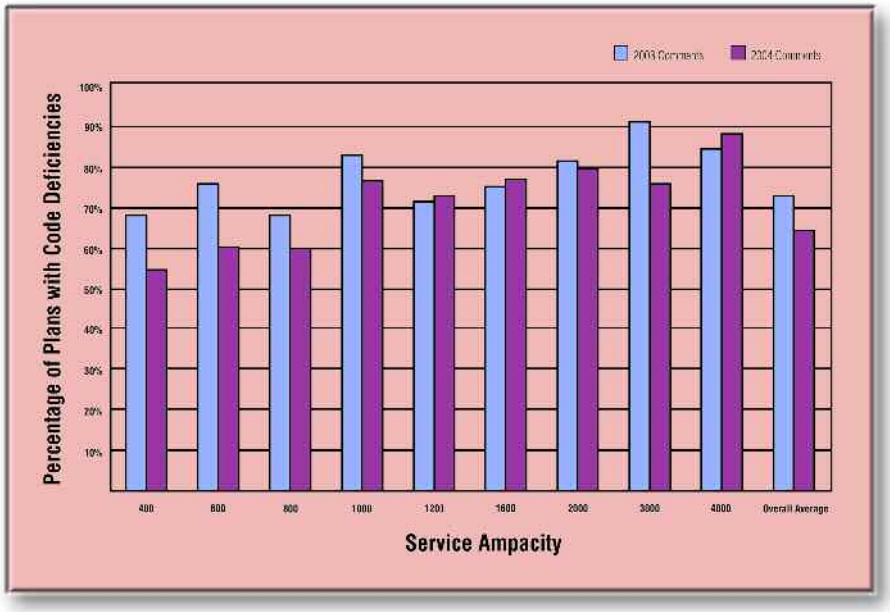
Further, the PEA, through section 72(2)(d) of Ontario Regulation 941, requires all engineers to make responsible provision for complying with "applicable statutes, regulations, standards, codes, by-laws and rules." This includes the OESC. So, under these circumstances, a professional engineer who is the author of such plans, or the engineer's firm, is required to submit plans to ESA. Failing to comply with the OESC requirement to submit plans might be viewed as professional misconduct under the PEA. (For information on plan submission requirements, refer to ESA Bulletins 2-11-11 and 36-1-16.)

Quality of plan submission

From January 1, 2004 to October 8, 2004, ESA received over 1950 plans submissions. ESA's goal is to complete the review and approval process within two weeks. During this period, the average turnaround time for low-voltage plans (under 750 volts) was about 6.5 business days. During eight weeks in May and June 2004, the turnaround time was more than 10 working days, the longest turnaround being 11.7 days. The average turnaround time for high-voltage plans was fewer than four days. ESA also has a process

in place to deal with rush requests. Incomplete submissions, or submissions with errors and deficiencies, invariably result in delays in review and approval beyond the target turnaround times.

ESA has also tracked the type and number of drawing deficiencies, and has shared this information with PEO. Unfortunately, this tracking has highlighted some disturbing results. From September 2003 to August 2004, 2295 plans were submitted to ESA and 69 per cent had technical deficiencies. PEO and ESA share concerns about this statistic. Are engineers who are responsible for electrical plans living up to their obligations with respect to code compliance and hence making "reasonable provision for the safeguarding of life, health or property?"



Percentage of code deficiencies relating to service ampacity

Common plan deficiencies

ESA plan approval staff have indicated that the most common errors and deficiencies in plans prepared and submitted by professional engineers are associated with cable sizing, overcurrent protection and ground-fault protection. To provide a better assessment, 90 drawings submitted by professional engineers were tracked to identify the most common errors. The top 12 errors, in descending order of frequency, are identified in Table 1.

Additionally, ESA has identified concerns about the quality of ground-potential rise and step-and-touch potential submissions in accordance with Rule 36-304 of the OESC. Given the extent of the deficiencies in some of these submissions, one might question the technical competence of the engineers responsible. Undertaking work that a practitioner is not competent to perform by virtue of the practitioner's training and experience falls within the definition of professional misconduct under the PEA. In other cases, it appears that computer-generated reports are being submitted with little or no review by the engineer or understanding of the results. PEO's guideline, *The Use of Computer Software Tools by Professional Engineers and the Development of Computer Software Affecting Public Safety and Welfare*, clearly establishes that engineers are responsible for verifying that results obtained from software are accurate and acceptable.

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When should drawings be sealed?

There is also a wide variance in practice associated with the sealing of drawings. PEO's practice bulletin, *The Use of a Professional Engineer's Seal* (January 2005), provides guidance in this area: "Seals must be affixed to final drawings, specifications, drawings or sketches accompanying change notices and site instructions, and studies containing technical information or engineering direction. The seal is also applied to forms for government or regulatory authority use." In this situation, drawings submitted to a regulatory authority should be sealed. This includes plans submitted to ESA for approval.

What should engineers do?

Professional engineers responsible for electrical plans should:

- understand their duties and obligations under the PEA, Regulation 941/90, PEO's practice guidelines, and the OESC;
- ensure they are familiar with the technical requirements of the OESC, especially in those areas that have been identified in this article;
- use the current edition of the OESC. The OESC includes all of the text of the CEC Part I, plus the Ontario administrative and technical amendments (which in some cases override the CEC);
- subscribe to the OESC bulletins. The bulletins provide in-depth information on the OESC, particularly for engineers, electrical contractors and electricians. They include additional guidelines and interpretations of the OESC and electrical safety flash notices.

Bulletins are one way an engineer can keep up to date on OESC matters. The OESC and bulletins can be purchased online at www.esasafe.com;

- contact an ESA technical advisor or code engineer to seek clarification on the requirements of the OESC. Their names and contact information are included in the bulletins;
- purchase a copy of the *Canadian Electrical Code Handbook*, published by the Canadian Standards Association. The handbook provides additional information on the electrical code rules, including their intent and rationale;
- improve their knowledge of the OESC. Code courses or seminars are offered by many organizations, including ESA, the Canadian Standards Association, universities, community colleges and other training providers;
- when using computer programs to assist in their work, engineers should be aware of engineering principles and correctly interpret and apply the results provided by software programs.

The next step is up to you

PEO, as the regulator of engineering practice, is responsible for ensuring that engineers live up to their obligations under the PEA. ESA, as the regulator of electrical safety, is responsible for ensuring that electrical plans and installations meet the requirements of the OESC. Our obligations intersect in our common responsibility for public safety. Both organizations have agreed to work together to improve the quality of electrical plans submissions. As regulatory bodies, we have various tools at our disposal, which include building awareness, providing or promoting education, seeking additional regulations, and initiating discipline or other compliance actions. Creating awareness among engineers is our first step to addressing the problem. The next step is up to you.

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Table 1. Common Drawing Defects

Rank	OESC Rule	Defect Type	Frequency
1	Rule 14-606	With the overcurrent device sized at XX A on the primary of the XX kva transformer, the secondary panel must be sized as per Rule 14-606 (2).	28
2	Rule 4-004 (1)(d)	The ampacity of the conductors from the pad mount transformer must be sized as per Rule 4-004 (1)(d).	8
3	Rule 8-104	The ampacity of conductors supplying a panel shall meet the requirements of Rule 8-104.	7
4	Rule 26-258	The ampacity of the conductors connected to the secondary of the transformers shall meet the requirements of Rule 26-258.	6
5	Rule 26-256	On the primary side of the transformer, the overcurrent device shall be rated or set at not more than 125 per cent of the rated primary current of the transformer.	5
6	Rule 14-012	Drawing indicates fusing will be installed in the secondary board. All Class R fuse holders used on circuit in excess of 10 kA of available fault current, shall be equipped with fuse rejecters to prevent non-Class R fuses from being installed.	5
7	Rule 12-012	The underground installation shall be identified as detailed in Bulletin 12-2-13.	5
8	Rule 14-102	Please note that Rule 14-102 requires ground-fault protection on grounded services less than 150 volts to ground and 2,000 amperes or more. It is the responsibility of the consultant, electrical contractor and switchgear manufacturer to co-ordinate the ground-fault sensing method with each particular grounding arrangement.	4
9	Rule 26-700 (11)	Receptacles located in bathrooms and installed within 3 m of washbasins shall be protected by a ground-fault interrupter.	3
10	Rule 14-606 (1)	Every panelboard shall be protected on the supply side by overcurrent devices having a rating not greater than that of the panelboard.	3
11	Rule 26-710	All stairwells shall have at least one duplex receptacle in each 10 m of length or fraction thereof.	3
12	Rule 36-214	(Tiebreaker installation) The main secondary breakers have no visible means of isolation or are not of a drawout type.	3