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STANDARDS IN CANADA
LES RÉSEAUX ÉLECTRIQUES AU QUÉBEC
ENERGY EFFICIENT MOTORS

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IEEE Canada

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IEEE Canadian Review General Information

The *IEEE Canadian Review* is published three times per year - Spring, Fall and Winter. The *IEEE Canadian Review's* principal objective is to project an **image** of the Canadian electrical, electronics, communications and computer engineering professions and their associated academic and business communities to :

(i) Canadian members of IEEE;

(ii) Canadian members of the profession and community who are non-members of IEEE;

(iii) the associated academic (i.e. universities, colleges, secondary schools), government and business communities in Canada.

In this context, the *IEEE Canadian Review* serves as a forum to express views on issues of broad interest to its audience. These issues, while not necessarily technologically-oriented, are chosen on the basis of their anticipated impact on engineers, their profession, the academic, business and industrial community, or society in general.

To ensure that the *IEEE Canadian Review* has the desired breadth and depth, Associate Editors are responsible for identifying issues and screening articles submitted to the *IEEE Canadian Review* according to the following general themes:

1- National Affairs
2- International Affairs
3- Industry
4- Education
5- Power
6- Communications
7- Computers

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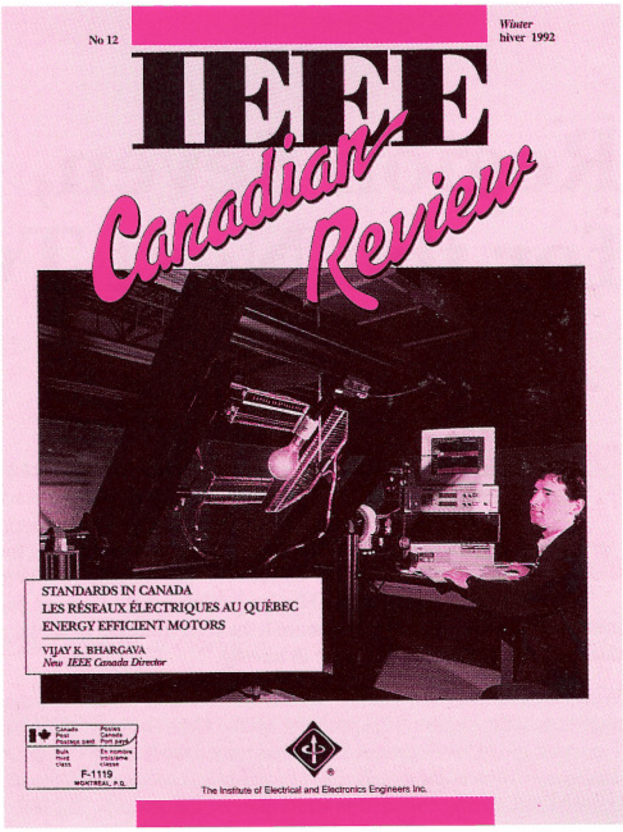

Cover picture

Our cover picture shows a computerized experimental setup to record the temperature profile of an incandescent lamp in one of CSA's testing and certification laboratories. It illustrates the level of expertise and sophistication that is typical of Canadian standards organizations.

Photo couverture

La photo de la page couverture illustre un montage assisté par ordinateur servant à enregistrer le profil de température d'une ampoule dans l'un des laboratoires de test et de certification de l'Association canadienne de normalisation (ACNOR). Par son ingéniosité, ce montage montre bien le degré d'expertise et de sophistication caractéristique des organismes canadiens de normalisation.

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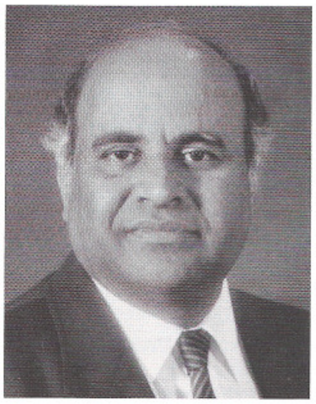
by Dr. Vijay K. Bhargava
Director, IEEE Canada



As the incoming Director of Region Seven for the years 1992 and 1993, I would like to express my appreciation to my predecessor Dr. Tony R. Eastham, both on behalf of the Region and personally, for his dedicated and energetic leadership during his tenure as the director. He effectively promoted and planned the Region's activities. His leadership would be hard for me to match, but I will do my best to continue the long tradition of leadership that our Region has been so fortunate in having.

With enthusiasm, I am looking forward to working with the old and new members of the Regional Committee. Micha Avni, Executive Director of the Transportation Development Center has joined the Executive Committee as Treasurer. I have appointed Dr. Greg Stone, Director of Research, IRIS Power Engineering Inc. as the Chairman of the Awards and Recognition Committee, and Dr. George Lampropoulos of Spar Aerospace as the Chairman of Educational Activities. The Region is quite fortunate to have these talented volunteers involved in these activities.

I would now like to share some thoughts with you for the next two years.

Although Electrical and Computer Engineers make important contributions to society, our profession does not have a public profile. When we, as a profession decide to speak out on policy issues such as the Canadian Government's R and D initiatives, someone has to be listening. Through common action with other professional societies, perhaps the electrical and computer engineering profession can gain a voice. How do we accomplish this?

Electrical and Computer Engineering education plays a key role in technological competitiveness. How do we encourage the best of our young men and women to choose electrical and computer engineering as a profession? We must make special efforts to make room now for "Daughters of Mary" to sit side by side with the "Sons of Martha".

Cooperation with the Canadian Society for Electrical and Computer Engineering (CSECE) will continue to be a priority item. I have established a blue ribbon committee consisting of Dr. Tony R. Eastham (Past Director of Region Seven) and Dr. B. John Plant (Past President of CSECE) and have requested them to explore avenues of further collaboration. In the meantime, we have agreed to co-sponsor the Canadian Conference on Electrical and Computer Engineering (CCECE), a CSECE initiative, designed to bridge the industrial and academic communities. Incidentally, our annual regional meeting will be held in Toronto during September 12 and 13, in conjuction with CCECE '92. Please note that the Regional Meeting is open to you as observers and you are invited.

Finally, I would like to solicit your input to the question posed at the last regional meeting, "What programs, services, and infrastructure will be needed for Electrical and Computer Engineers and their profession in Canada in 2001?" You can reach me electronically at 604-721-8617 (voice), 604-721-6048 (FAX), or bhargava@sirius.UVic.CA (E-mail).

If you happen to be in Victoria, please do call on us. ■

BIOGRAPHICAL NOTE

Vijay K. Bhargava was born in India on September 22, 1948 and graduated form Queen's University on Mathematics and Engineering in 1970. He also received M.Sc (1972) and Ph.D (1974) degrees in Electrical Engineering from Queen's University.

He has held academic research appointments at the Indian Institute of Science, University of Waterloo, Concordia University, École Polytechnique de Montréal. In 1984 he joined the newly formed Faculty of Engineering at the University of Victoria as a Professor, and in 1988 was appointed a Fellow of the British Columbia Advanced Systems Institute.

In 1983 he became the Founder and President of Binary Communications Inc., a company which has successfully developed software and hardware for error control coding devices used in several commercial wireless communications systems. Vijay is a co-author of the book "Digital Communications by Satellite", a 1981 Wiley publication. He is on the Editorial Board of three journals and has served as the Associate Editor and Editor of the Canadian Journal of Electrical and Computer Engineering.

Vijay has founded three conferences; namely, the IEEE Pacific Rim Conference on Communications, Computer, and Signal Processing (Victoria 1987), the Canadian Conference on Electrical and Computer Engineering (Vancouver 1988) and the International Conference on Selected Topics in Wireless Communications (Vancouver 1992).

A Fellow of the Engineering Institute of Canada (EIC) and of the IEEE, Vijay received the IEEE Centennial Medal (1984), EIC Centennial Medal (1987), A.F. Bulgin Premium of IEE (U.K. 1987) and the EIC Sterling Medal (1990).

Vijay is married to the former Yolande Henri of Warwick, Québec. They have two children.

Standards Council of Canada

Integrator of Canadian Standards Activities

by Michel Bourassa
Senior Program Officer
International Standards Division,
Standards Council of Canada

Standards are an essential tool in today's marketplace. As national markets evolve into a few regional, and possibly into one global market, standards become increasingly important. The Standards Council of Canada manages Canada's National Standards System (NSS). The members of the NSS provide Canadians with the standards they need as the market evolves, along with related services, such as product certification, independent testing, and registration of Quality Management processes.

Dans le marché actuel, les normes sont un outil indispensable. Leur importance ne cesse de croître avec l'évolution des marchés nationaux vers un nombre restreint de marchés régionaux, et éventuellement vers un marché mondial unique. Le Conseil canadien des normes gère le Système de normes nationales du Canada (SNN). Les membres du SNN fournissent aux Canadiens les normes nécessaires, à mesure que le marché évolue, ainsi que des services connexes, tels que la certification de produits, des essais indépendants et enregistrement des processus de gestion de la qualité.

Recently, Canada Wire and Cable Ltd. became the first power cable plant in North America to be accredited to both ISO 9002 and CSA CAN3 Z299.2 — two stringent quality assurance standards. It was the result of some tough work and decision-making that began five years earlier.

"If we were to prosper in the future," said company President Peter Green, "indeed, if the company were to be assured survival in the long term, it was going to be necessary to reduce our costs by at least 20 per cent."

Canada Wire's survival plan was to initiate a quality assurance program. Today, that decision is still paying off. There have been notable increases in productivity, inventory reductions of 40 per cent, scrap reduction of 70 per cent or more, greatly reduced absenteeism and grievances, and overall lower production cost per unit, not counting improvements due to investment in new equipment.

This company, now Alcatel - Canada Wire, has become an industry success story, and a standardization success story. Through judicious use of internationally developed and nationally implemented standards, the company's products have gained ready market acceptance.

But the company's story is not unique. In recent years, the emphasis on quality, efficiency and globalization of trade has elevated standardization to a new level of importance. But just how does standardization work? Who are the players involved? What is happening on the international scene? And what is the role of the Standards Council of Canada, the country's national standardization body? These are questions that an increasing number of people are beginning to ask — and rightly so.

By its simplest definition, a standard is a tool to assist the market. The key to understanding the rationale for a standard is to know the market it is intended to serve.

In Canada, there are a number of organizations involved in standardization. The Standards Council of Canada (SCC) is the federal crown corporation mandated to promote the orderly advancement of standardization. It manages the National Standards System (NSS) a federation of some 90 organizations engaged in standards-writing, certification, testing and quality systems, and delivers information on standards to both Canadians and foreigners.

Part 1 of this article explains how standards are developed, and Part 2 shows how the standards are used to assist various market needs.

Through management of the National Standards System, SCC integrates the activities of a wide variety of autonomous organizations that provide standards services; be they standards development on a national or international basis, third party certification services, or independent testing services.

Volunteers are the backbone of SCC and the NSS. Volunteers representing diverse Canadian interest groups formulate SCC policy. In addition, some 10,000 volunteers from all sectors of the Canadian economy and government write standards.

PART 1 — STANDARDS DEVELOPMENT

National Standards

Any group in Canada may develop and publish standards on any subject. However, if the group wishes to be recognized as developing standards in a way

In the 1990's, successful companies are becoming increasingly cognizant of the benefits of standardization. Some of Canada's most respected organizations have been accredited by the Standards Council of Canada to engage in standards-writing, certification, testing or quality systems registration. Pictured here (*facing camera, center to right*) are **George Archer**, President of the Standards Council, **Pierre Perron**, President of the National Research Council of Canada, and **Graham Sadler**, President of Northern Telecom Electronics. They are touring a Northern Telecom Electronics Calibration Lab which was recently accredited by the Standards Council. Answering questions is calibration technologist **Dennis Bergland**.

Progress in standardization is usually achieved through the efforts of volunteers participating in committees. The Executive Committee of the Standards Council of Canada, pictured here, oversees the operations of the crown corporation between plenary meetings of Council. Other committees advise Council on policy areas. Appearing clockwise starting at head of table, are: **Georges Archer**, President of the Standards Council, **Conrad Maheux**, **Richard Lafontaine**, **Wally S. Read**, **Philippe Fontaine**, **Jean Gariépy**, **Rick Parsons**, **Jack Perrow**, **Larry Moore**, **Gilles A. Baril**, **Judy C. Holden**, **John E. Kean**, **John R. Woods**. To the left, **Lloyd Duhaime**, Secretary of the Council.

which ensures consensus amongst affected parties, as well as being permitted to publish nationally approved standards, it must obtain accreditation from SCC as a Standards Writing Organization (SWO). SCC's criteria for accreditation include:

- a true consensus environment
- consideration of international standards
- public review of drafts

Each Standards Writing Organization is accredited to develop National Standards of Canada (NSC) in specific disciplines. This reduces jurisdictional overlaps and permits efficient use of volunteer resources. The Canadian Standards Association (CSA) is accredited to develop standards in the electrical/electronic areas; it is the SWO most familiar to Canadian IEEE members. In addition to CSA, other accredited SWO's are:

BNQ	Bureau de normalization du Québec
CGA	Canadian Gas Association
CGSB	Canadian General Standards Board
ULC	Underwriter's Laboratories of Canada

CSA, CGA, and ULC are all private, not-for-profit organizations, funded by member contributions and sales of standards; BNQ is affiliated with the Quebec government, and CGSB is a federal agency.

The strength of these organizations lies in their voluntary members who spend many hours studying, discussing, and developing standards. It is estimated that around 1000 Canadian IEEE members devote energies to establishing Canadian standards, primarily those of CSA.

SCC will designate a standard as a National Standard of Canada provided that:

- the standard is submitted by an accredited SWO,
- the topic falls within the SWO's recognized subject area,
- the standard does not conflict with other NSC's,
- the consensus process was used in the development of the standard.

Recognition of a standard as a National Standard of Canada is a way of telling Canadians, as well as the world, that this is the standard used in Canada. National Standards of Canada are identified by adding CAN/ to the number, e.g. CAN/CSA C22.2 No. xxx.

Other groups have evolved to support the NSS. For example, a recent joint initiative of Communications Canada and SCC resulted in the creation of the Telecommunications Standards Advisory Council of Canada, whose objective is to provide a focus for the development and implementation of Canadian telecommunications standards strategies.

As the market shifts from a national to a regional, and ultimately to a global perspective, the participants all need to know the technical requirements of their target markets.

Canadian/U.S. Harmonization

As markets become increasingly international, so must standards. John Kean, President of CSA, recently told the Canadian Seminar on Information Technology and Telecommunications Standards, "If we believe in the open market concept, and the eventual development of a truly global marketplace, then the ideal situation, at least from a manufacturer's point of view, would be 'one product-one standard', with the standard being accepted in each and every country where the manufacturer of the product wishes to trade."

To help Canadians participate in markets external to Canada, CSA encourages its standards-writing committees to adopt or endorse standards of an international character such as those of IEC/ISO, or IEEE. The source material will depend on the specific topic; for the Information Technology industry IEC/ISO predominate, while in the power distribution industry IEEE has a strong presence, with an example of an adopted IEEE standard being CAN/CSA-C22.2 No. 241-M91 (IEEE 404-1986) covering joints for medium and high voltage cable.

The Free Trade Agreement has resulted in the establishment of several bi-national standards-setting task forces with direct participation of CSA, ULI (the U.S. Underwriter's Laboratory), EEMAC, and NEMA*. These groups resolve discrepancies between Canadian and American standards.

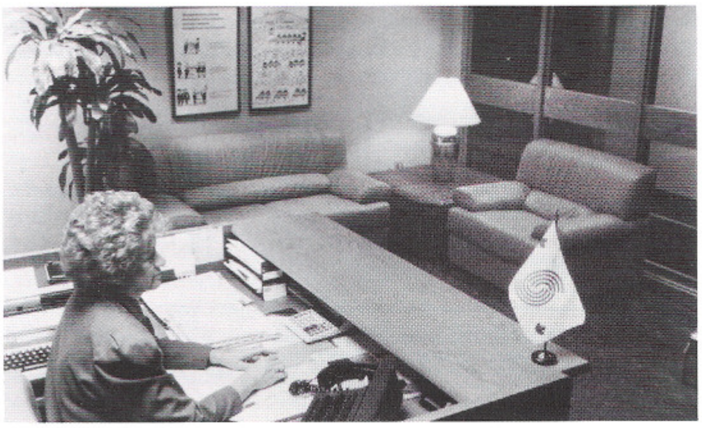
In some markets it is impossible to change immediately to bi-national or international standards. In such cases, it is preferable to issue a *bridge standard*, based on international standards, but clearly indicating those modifications that are necessary to accommodate existing Canadian conditions. One example of this is CSA-C22.2 No. 601.1-M90, Medical Electrical Equipment, using as much of IEC 601-1 as possible.

International Standards

There are several organizations that issue international standards. SCC concentrates Canadian interest in the two which publish 85 percent of the international standards: IEC (International Electrotechnical Commission), and ISO (International Organization for Standardization). IEC was first established in 1906, addressing electrical and electronic subjects, while ISO, since 1946, covers the rest.

The Canadian member at IEC is the Canadian National Committee of the IEC (CNC/IEC), first established in 1911. It is sponsored by SCC since 1972. On the other hand, at ISO, the SCC is itself the Canadian member.

The CNC/IEC is composed of around 20 volunteers, several of whom are members of IEEE. As a standing committee of SCC, the CNC/IEC decides on Canadian policy positions within IEC, and sets policies for the functioning of the numerous Canadian Sub-Committees in which Canada is interested. SCC provides staff to carry out the policies, issue Canadian positions, and assist Canadians to effectively participate.



The Standards Council of Canada is the federal Crown corporation charged with fostering and promoting standardization. To fulfill its mandate, the Standards Council manages the National Standards System, a federation of some 90 organizations engaged in standards-writing, certification, testing and quality systems registration. The Standards Council's offices (reception area pictured here) are located on O'Connor Street in Ottawa, a short distance from Parliament Hill.

** EEMAC is the Electrical and Electronic Manufacturers Association of Canada. NEMA is the National Electrical Manufacturers Association (USA).*

The IEC/ISO standards development process is indicated in Figure 1. Initiating a project used to consist primarily of a country suggesting that its standard be adopted — usually resulting in a 'not-invented-here' response and many years of discussion. The figure illustrates that today an international standard does not reach completion until it has been incorporated into the national standards of participating countries.

Canadians have always been well received at IEC. Our status as a neutral nation, combined with our Pearsonian diplomatic talents, results in Canadians frequently assuming a mediation role — a situation beneficial to both Canada and the international standardization community.

SCC pays close to one million dollars a year for Canadians to be permitted to participate in IEC/ISO deliberations. Clearly, IEC and ISO exist so nations can agree on common standards which they can then take home and implement to benefit their markets.

Integration of Canadian national and international interests is achieved by having Canadian SWO's recommend the positions that Canada should take internationally on parallel subjects. When an SWO committee decides to do this, it is called *harmonization*. The major benefit that results is that Canadian standards can be written in full knowledge of international developments. Another benefit is that Canadian solutions are sometimes adopted internationally; an example is IEC 1089, Round wire concentric lay overhead electrical stranded conductors (published 1991 05), which is almost identical to CAN/CSA-C49.1-M87.

Speed-up of International Work

The 12 member nations of the European Community have agreed to adopt standards developed by European standards-writing organizations: CEN (Comité Européen de Normalisation), CENELEC (CEN-Électrique), and ETSI (European Telecommunication Standards Institute).

Politicians of the European Community have instructed the standardizers (CEN, CENELEC, and ETSI) to adopt IEC and ISO standards. There must be a compelling reason not to do so — such as the inability of IEC and ISO to deliver norms in time to be useful. The adoption rate is remarkably high; 85 percent of CENELEC standards are straight adoptions of IEC standards.

This European challenge to IEC/ISO has resulted in sweeping changes to the procedures for standards development in the two organizations, along with more advanced project tracking. Still more changes are in store to speed up the process and to ensure that standards are delivered to the market in time to be useful.

Rapprochement of IEC/ISO:

With the advent of Information Technology (IT), a blurring of the dividing line between electronics and information exchange has occurred. The result has been a rapprochement of IEC and ISO.

The two organizations have created a Joint Technical Committee (JTC1). This JTC develops information technology standards using its own procedures, borrowing from established practices of both parents, but focusing on the need for speed because of the rapidly evolving IT market.

As regards long-term planning, IEC and ISO joined forces in 1987 to better respond to the increasing demands on international standardization.

IEC and IEEE — Competitors or Companions?

IEC and ISO's primary mission is to deliver international voluntary standards to satisfy the needs of the market. Ideally, the technical validity of various solutions offered up at the standards-writing table has already been explored in other technical fora, thus eliminating a great deal of preliminary discussion.

IEEE on the other hand, offers a forum for the discussion of common engineering problems. The primary goal is to explore and resolve technical problems; the publishing of standards is secondary.

However, in the field of Local Area Networks (LANs), IEEE has been recognized as providing the best international arena to resolve technical problems and issue standards — to the point that ISO and IEC have agreed to make IEEE the standards development forum in this field of expertise. A typical standard is ISO 8802-2 (ANSI/IEEE 802.2) for logical link control.

Resources for standards development are becoming scarcer. It is appropriate that organizations such as IEEE and IEC/ISO cooperate in ways that will best suit the market's needs.

Regional Cooperation:

Although each member-country has an equal vote at IEC, various regional groups have evolved to discuss matters of common interest. In Europe, there is CEN, CENELEC, and ETSI, while the Pacific rim members discuss policy matters within the Pacific Area Standards Congress (PASC).

At IEC and ISO, when both Canada and the U.S.A. express a similar position, it is accepted as the North American position and accorded a status comparable to the European position, even though the European countries have many more votes. If Canada and the U.S.A. disagree, or only one country is active, North American views are given much less consideration. The volunteer participants of Canada and the U.S.A. have quite often been able to develop complementary positions at IEC through discussions that first took place within the IEEE framework - with excellent results.

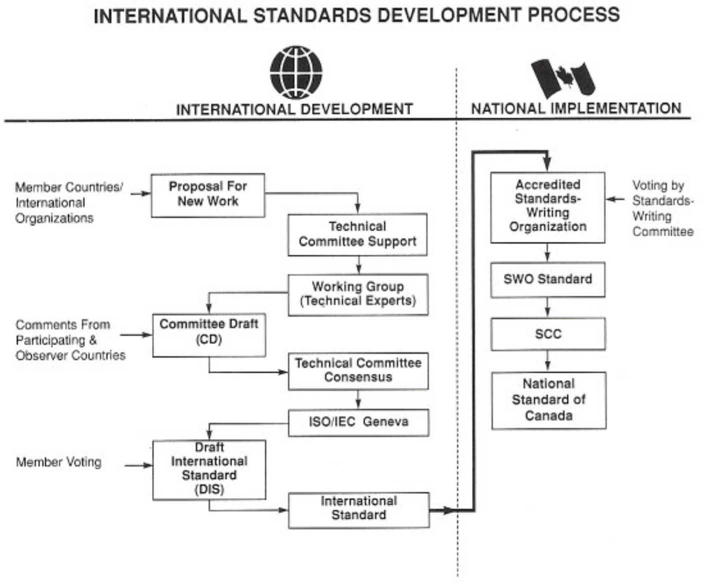


Figure 1: Flow diagram illustrating the IEC/ISO standards development process.

PART 2 — USE OF STANDARDS

The first part of this article described how the National Standards System (managed by Standards Council of Canada) permits Canadians to effectively develop national standards and participate in the development of international standards.

The finished product, a standard, is then put to work to the benefit of the participants in the marketplace. The different ways that standards are used will now be explored, covering (1) referencing, (2) certification, and (3) testing.

A major benefit of standards is that they represent a consensus-based solution to a problem. Those facing the problem have confidence that the solution is valid and will therefore collectively use the standard. The most common use is simply to reference the standard in documents.

Referencing Standards in Contracts

Contracts can be made very clear, simple, and short through references to appropriate standards. Much of the goods sold in Canada are handled in this manner, with the major example being supplies of raw material and semi-processed goods to original equipment manufacturers. In the electrical power industry, many standards are referenced in the procurement of equipment, supplies, and services, as well as in guides for installation or operation.

Referencing Standards in Regulations

Where safety and health are a prime concern, regulators (federal, provincial, or municipal) will pass laws governing the activity or product. The language of the regulations is much simplified, and compliance made much easier, through reference to consensus-developed standards.

The federal governments of both Canada and the U.S.A. have recognized the benefits of this approach, and have issued directives to the various government departments to participate in the development of standards, and then to reference them. This approach is expected to eliminate detailed regulations which lag technology and are written in language which often tends to confuse.

Electrical safety of the public is a provincial matter in Canada. Early on in the electrical industry, it was recognized that uniform rules across Canada made sense to the suppliers of equipment, the installers, the consuming public, and the regulators. The diverse parties joined forces under the umbrella of the Canadian Engineering Standards Association (later to become CSA) to formulate the Canadian Electrical Code. It expresses, in detail, safety standards for electrical installations as well as for electrical equipment.

The Canadian Electrical Code forms the basis for provincial laws with only minor deviations. This coherent system has been envied by many other countries and is frequently used as a model.

Standards and Certification

Standards provide the criteria for products to be judged as fit for the purpose they were intended. Certification of a product (or service) is accomplished in three ways:

- third party certification,
- registration of quality management programs,
- manufacturer's declaration.

Third Party Certification

The market often requires that products or services be verified by an independent third party. Suppliers want credibility, while users want independent verification of the manufacturer's claims. Third party certification provides the answer.

Certification is usually associated with federal, provincial or local health and safety regulations. For electrical products, these regulations are the domain of provincial governments. They normally require that products be certified as complying with CSA Standards. CSA itself has been offering certification services, through its certification division, since the 1950s.

The process begins with a thorough examination of a product sample, to determine conformance to the standard. If the product passes inspection, the manufacturer is given permission, under contract, to affix the certification organization's mark to the product. Provisions of the contract ensure continued conformance. For instance, the certification organization is given free access to inspect production facilities.

SCC operates an accreditation program for third party certifiers. The accreditation program verifies that the certification agency has competent personnel, access to independent laboratories, and a structure that ensures its technical judgements are free from client influence.

Certification organizations now accredited by SCC are:

CSA	Canadian Standards Association
CGSB	Canadian General Standards Board
CGA	Canadian Gas Association
COFI	Council of Forest Industries (B.C.)
ULC	Underwriter's Laboratories of Canada
WHPS	Warnock Hersey Professional Services
CWB	Canadian Welding Bureau

The Canadian Welding Bureau certifies the skills of welders, and is an example of how *services* can be certified.

Competition and third-party certifiers

Until recently, there has been little overlap, and therefore little competition, amongst Canadian certification organizations. However, two recent political developments are changing this situation.

First, some provinces accept the mark of any SCC accredited certification organization rather than only that of CSA. This has enabled WHPS to certify electrical products in its SCC-accredited areas.

Second, the Free Trade Agreement requires SCC to consider U.S.-based certification organizations for accreditation. There are now a number of applications before SCC, with the possibility that SCC will have accredited a U.S. certifier by the time this article is published. The result will be streamlined applications for certification to meet both U.S. and Canadian requirements for the manufacturer. The other beneficiaries of the certification process (regulators and end users) will no longer be able to rely on a single mark of compliance, but will need to become familiar with additional marks; the information will be available from SCC.

International Certification Schemes

International trade can be facilitated by reducing the number and variety of certification schemes in the world. Such international schemes offer an expanded market coverage.

Participation in this program will make it easier for Canada to export electro-medical equipment and information technology products into other participating territories. Most of Europe and the major Asian countries are members. Canadian membership will also speed up regulatory approval of products imported into Canada from the other participating countries.

ISO is making one-stop, world-wide certification a reality through its Committee on Conformity Assessment (CASCO). This group issues international guides that are used to judge certification organizations. These guides also provide a common language for exchanges amongst all interested parties.

The ISO guides form the basis for the policies and procedures that SCC uses to accredit Canadian certification organizations.

Certification organizations now use ISO's 'common language' to establish bilateral and multilateral agreements. The market will dictate how fast national organizations (such as SCC) establish formal agreements to honour each other's certification schemes.

No matter how you like to do your research - by fax, phone, modem, telex or in person - the Standards Council of Canada's information service, pictured here, is equipped to help you. Information officers can answer almost any question related to the standards and regulations of Canada and its trading partners. The Standards Council maintains numerous advanced research tools, in addition to its extensive library of standards and standards-related documents. It can be reached toll-free from anywhere in Canada (see sidebar).

Registration of Quality Management Programs

Quality Management has become key to delivering a reliable product on time to an ever more discriminating customer. Alcatel-Canada Wire has adopted this philosophy, and is now well positioned to meet its customers' needs.

The Canadian nuclear industry was the first to recognize the advantage of relying on a supplier's well-managed product development/delivery system in place of customer acceptance testing.

The concept found favour with the Canadian electrical generation and distribution industry, was further refined, and led to the establishment of CSA's Quality Management Institute (QMI) which registers companies that operate in conformance to quality management principles.

Similar developments were occurring in other areas of the world, most notably in Japan and Europe. ISO TC176 was formed to develop internationally-agreed quality management standards. SCC took on the secretariat of this ISO Technical Committee, and under the leadership of two Canadians (the Secretary and the Chairman of ISO TC176), this TC has succeeded in issuing ISO's biggest seller ever, the ISO 9000 series of standards.

Registration of a company to one of the ISO 9000 levels is rapidly becoming the key for participation in many markets around the world. This registration is used to supplement and facilitate third party certification, and in some instances to replace it.

There is a clear advantage to internationally accepted quality assurance registration. To this end, SCC is establishing an accreditation program for Quality Management registrars located in Canada, and is encouraging the formation of an international organization of accreditors, through ISO CASCO.

Manufacturer's Declaration

When safety and health are not a primary concern, it is often acceptable for a manufacturer to declare that a product conforms to a standard. In fact, this is the most common 'certification' used for products in the electrical generation and transmission industry.

The advent of quality management registration is instilling greater confidence in manufacturers' declarations, thus improving market efficiency.

Use of Standards in testing

Products are normally tested to determine conformance to a standard, so it is important to be sure that test results are valid. This is the reasoning behind SCC's accreditation program for testing laboratories. Accredited laboratories must demonstrate:

- their ability to perform the tests listed
- independence of management from those affected by the results

U.S. Lab Accreditation

Like its certification-organization accreditation program, SCC's testing-laboratory accreditation program must be open to American laboratories as a requirement of FTA. SCC is doing this by two routes: first, by direct accreditation and second, through reciprocal agreements with U.S. accreditors of test labs. At this time, SCC has an agreement with the U.S. National Institute of Standards and Technology (NIST) on their National Voluntary Laboratory Accreditation Program (NVLAP); agreements with other US accreditors are being pursued.

Metrology Laboratories

An agreement between SCC and NRC's world renowned Calibration Laboratory Accreditation Service has resulted in a first rate program for accrediting calibration labs.

International accreditation of laboratories

The International Laboratory Accreditation Conference (ILAC) is a coalition of parties concerned with international recognition of test results. Internationally recognized accreditation requirements will facilitate the exchange of reliable information and establish the trust required for reciprocal acceptance.

ILAC meets every two years, and SCC will host its next meeting in October, 1992 in Ottawa.

Most countries that are interested in participating in an international scheme for reciprocal acceptance of test data have a single organization, such as SCC, that accredits test labs. The expectation amongst the players is that each country will have a single organization that is empowered to sign agreements of an international nature. This is not the case in the U.S.A. and it is causing confusion amongst their trading partners, and is seen as a hurdle to an effective international scheme.

Conclusion

Standards do not just arrive out of the blue. They are the result of the deliberations of many individuals who wish to give to the world the fruits of their hard-won experience, assisted by organizations with a financial stake in the outcome, within a framework provided by standards writing organizations.

Corporations and government agencies need to include standards development into their strategic plans. There are three choices:

- participate actively to influence the outcome, to have the requirements match your projected capabilities;
- observe closely to identify standards projects that are nearing maturity - know where the competition is headed;
- ignore developments and simply adapt to new requirements after they are published - i.e., be a "me-too" participant in a market of established standards.

Once published, standards can be used in a variety of ways - as a reference, in certification or in testing a product - all with a view to assisting the market.

The Canadian market is in rapid transition from a self-sustaining island to a partner in a large regional economy, and to a global economy in some cases.

Canadians need to enact strategies to keep their rightful place in the market. Involvement in standards development and related areas can provide intelligence as to which way the market is going, as well as opportunities to influence the outcome to match Canadians' strategic plans.

SCC serves as the arena to integrate all of the diverse standards activities that are beneficial to Canada, and provides credibility to the participants of Canada's National Standards System. ■

About the author

Michel Bourassa is a Certified Engineering Technologist with a Diplôme d'Études Collégiales from Collège Ahuntsic and further study in Electrical Power Technology at Ryerson Polytechnical Institute. He is a Member of IEEE since 1986. His 18 years industrial experience includes front-line and management positions in product design, testing, production, quality assurance, approvals, and standards. "Mike" is Senior Program Officer in the International Standards Division of the Standards Council of Canada since 1987.

Standards information at your fingertips

When you're too busy to get standards information by phone, and you're in too much of a hurry to wait for the mail, the Standards Council has an attractive alternative.

Using your computer and modem, you can gather information about Canadian standards, standards referenced in legislation, draft European standards and notifications issued under the GATT Standards Code. The databases are available 24 hours a day.

In addition to its data-bases, the Standards Council offers a wide range of information and sales services. These include:

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- Sales of foreign and international standards
- *Europe '92: Trade Winds:* A newsletter on the changing European standards
- *CONSENSUS,* Canada's national standardization magazine
- Videos and brochures on a wide range of topics

To subscribe to *CONSENSUS* or *Europe '92: Trade Winds,* or to request a list of publications and videos, you should call (613) 238-3222, fax your request to (613) 995-4564, or write/visit the Standards Council of Canada, 1200-45 O'Connor St., Ottawa, Ontario, K1P 6N7.

For information on standards, or to purchase a standard, call toll-free to 1-800-267-8220.

CSA and Standards Development

Establishing the quality and safety of Canadian products, services and installations

by Paul Bates
Manager, Electrical, Electronics and Communications Standards with CSA

I have been a member of IEEE for many years, and am pleased to have this opportunity to explain CSA's standards development process, and describe some of our programs.

First, I'd like to correct some commonly held misconceptions about the Canadian Standards Association, more generally known by its acronym CSA.

CSA is non-governmental. We are an independent, not-for-profit service association, with approximately 7 500 members. Established in 1919 as the Canadian Engineering Standards Association, we are the oldest and largest Standards-writing organization (SWO) in Canada. CSA employs approximately 900 people and has offices in Moncton, Montreal, Toronto, Winnipeg, Edmonton, Vancouver, Taiwan, Hong-Kong, Tokyo and Brussels.

CSA does not write Standards. CSA Standards are written by *volunteers* working together on CSA committees. Committee volunteers come from business, government, research organizations, and consumers.

CSA administers the process of Standards development, but our more than 7 500 volunteers do the technical work .

CSA does not mandate Standards. Being non-governmental, CSA has no regulatory or legislative authority. For any Standard to become mandatory, it must be referenced by the authority having jurisdiction. For example, the Part II Standards of the Canadian Electrical Code are mandated by provincial law. To offer electrical products for sale without CSA certification or special approval by the respective electric utility, is a violation of provincial law.

A large number of CSA Standards remain *voluntary.* Although not required by law, voluntary Standards may be a customer requirement for reasons of quality, performance, compatibility, and so forth.

CSA administers Standards development programs in the following broad areas:

- Business Management Systems
  - quality management
  - basic engineering (fasteners, drafting, SI units, etc.)
- Construction
  - building materials and products
  - concrete and masonry
  - forest products
  - plumbing products and materials
  - industrialized building construction
  - structures (design)
- Electrical and Electronics
  - Canadian Electrical Code - Parts I, II and III
  - electrical engineering Standards
  - performance of electrical products
- Communications
  - telecommunications
  - electromagnetic compatibility
  - information technology
- Energy
  - renewable energy
  - nuclear
  - energy conservation in housing
  - fire safety and fuel-burning equipment
- Materials Technology
  - welding
  - metallurgy
- Transportation and Distribution
  - automotive safety
  - offshore structures
  - materials handling and logistics
  - oil and gas industry systems and materials
- Lifestyles and the Environment
  - health care technology
  - public safety
  - mine safety
  - occupational health and safety
  - sports and recreational equipment

Consensus is the basic ingredient in all CSA standards. This volunteer CSA Consumer Advisory Panel met in Halifax in June 1990, to discuss Educational Strategies for CSA. The moderator was **Linda Lusby** of Acadia University. CSA has many Consumer Advisory Panels for Consumer input to the consensus process.

Electrical and Electronics Program

The Electrical and Electronics Standards program is organized under five Standards Steering Committees:

Canadian Electrical Code Part I
Canadian Electrical Code Part II
Canadian Electrical Code Part III
Electrical Engineering Standards
Performance of Electrical Products

The objective of the Canadian Electrical Code program is safety. Part I deals with the safe installation of electrical services, Part II with the safety of electrical products, and Part III with the electric utility distribution system ("outside wiring").

There are over 200 Part II, or product Standards, serially designated as C22.2 No. 1, C22.2 No.2, etc. They are grouped under five Technical Committees, which report to the Steering Committee. The Technical Committees carry the titles General Requirements, Wiring Products, Industrial Products, Environmental Products, and Consumer and Commercial Products. Table 1 lists a few representative topics under each heading.

The Part II Steering Committee has overall responsibility for developing and maintaining the Part II Standards. The detailed technical work associated with each of the 200-plus Part II Standards is accomplished by technical subcommittees, composed of small groups of experts, reporting to their respective technical committees.

The Canadian Electrical Code Part III Committees develop Standards pertinent to outside plant, such as overhead lines, grounding of supply stations, inductive coordination, corrosion, underground systems, coordination with pipelines, etc.

Electrical Engineering Standards develops Standards that deal with equipment used by the power utilities, such as distribution transformers, metering equipment, and a variety of power-cable types and hardware.

The Steering Committee on Performance of Electrical Products, is developing a comprehensive series of Standards on energy efficiency of electrical equipment. They establish levels of energy efficiency performance and methods of measurement. Products covered include appliances, cooling and heating equipment, hot-water heaters, motors, and lighting. These Standards are being referenced in provincial legislation dealing with energy.

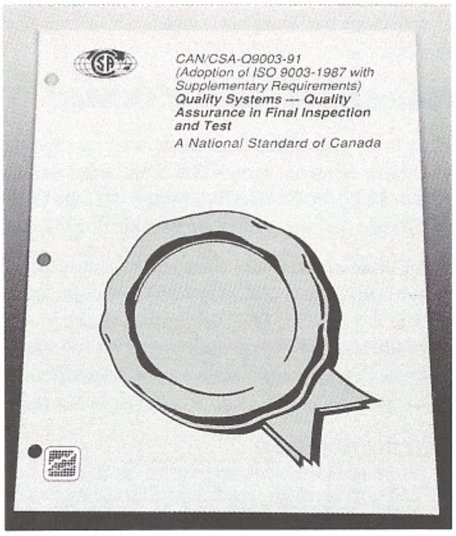
Telecommunications and Information Technology Program

The Communications and Information Technology program of Standards development is organized under three Steering Committees:

Telecommunications
Electromagnetic Compatibility & Power Quality
Information Technology

TABLE 1 CANADIAN ELECTRICAL CODE (PART II) STANDARDS TECHNICAL COMMITTEES

General Requirements	Wiring Products	Industrial Products	Environmental Products	Consumer and Commercial Products
Double Insul-	Wire & Cable	Breakers	Lighting	Radio & TV
ated Equipment	Receptacles	Industrial	Heating &	Appliances
Bonding &	Junction boxes	enclosures	Cooling Equip't	Water Heaters
Grounding	Connectors	Switchgear	Hydro massage	Office Machines
Polymeric	Raceways	Cranes & Hoists	Medical Equip't	Computers
Compounds	Conduit	Motors	Ballasts	Power Supplies
Adhesive labels	Tubing	Chargers	Air Cleaners	Electric Tools
etc.	etc.	etc.	etc.	etc.



This CSA Quality Assurance Standard is harmonized with ISO and forms part of the important ISO 9000 series. Its *CAN* prefix indicates that it has been accredited by the Standards Council of Canada to become a National Standard of Canada.

The Steering Committee on Telecommunications (SCOT) is responsible for developing Standards dealing with the *periphery* of the telephone network. Their Standards can generally be broken into three categories: telephone sets and private branch exchange (PBX) equipment, telecommunication facilities in buildings, and integrated-services digital network interface (ISDN) Standards.

The Steering Committee on Electromagnetic Compatibility (EMC) and Power Quality deals with Standards relating to inter-equipment interference: power levels, measurement, and susceptibility. Current activity relating to power quality includes developing a Standard for the measurement of power-line harmonics which may be generated by certain types of electronically-controlled power equipment.

The Steering Committee on Information Technology deals with computer communication and information processing Standards. Much activity deals with open-system interconnection (OSI) standard protocols.

The Consensus Development Process

CSA provides administrative support for the committees and manages the consensus process according to strict rules of procedure listed in the *CSA Regulations Governing Standardization*. We take considerable pride in the effectiveness and timeliness of our process; on the average, CSA can develop and publish a standard in just 18 months. This is considered to be very fast for a Standards-writing organization.

The Technical Subcommittees (SC's) develop requirements for new Standards, new editions, and amendments. The final draft of the requirements is submitted to a formal two-level balloting process, which involves the Technical Committee (TC) and the Steering Committee. The TC (first level) votes on the technical content, while the Steering Committee (second level) votes on the procedural, non-technical aspects.

The approval process also includes a mandatory public review period, wherein the public is notified of the activity via CSA's magazine *Information Update*, and comments are requested. Anyone may subscribe to this magazine; several thousand copies are distributed six times a year by CSA.

The procedures ensure that minority viewpoints are heard; all negative votes and comments must be duly considered, with the opportunity given to write *minority reports* for consideration by the Committee.

Membership of the TC's and Steering Committees is managed by CSA, to ensure that it remains reasonably "balanced" - i.e., that it includes an equitable mix of *producer, user, general-interest, and regulatory authority* representatives, for the product concerned.

National Standards of Canada

CSA is an accredited Standards-writing organization, within the National Standards System. Most CSA Standards (voluntary and regulated) become approved by the Standards Council of Canada (SCC) as National Standards of Canada and are published in both English and French.

The Canadian National Standards System is administered by the SCC (a crown corporation affiliated with Consumer and Corporate Affairs, Canada). Within the system, SCC accredits Standards-writing organizations, testing laboratories, and certification agencies for specific fields of technology for Canada. For an organization to be accredited, its facilities, personnel, and procedures must meet and sustain rigorous requirements.

Harmonization

As a member of the National Standards System, CSA's committees are linked with, and often participate directly in the work of international Standards committees — i.e., those of the International Organization for Standardization (ISO) or the International Electrotechnical Commission (IEC). In many cases, CSA committees *adopt* the international Standard as the Canadian Standard. Examples include IEC 950 on Information Technology Equipment adopted as C22.2 No. 950.

When the need exists, CSA will assume a leadership role in Canada's participation internationally. For example, CSA holds the international secretariat for the ISO Technical Committee on Quality Assurance.

Over the past two years, in response to requests from industry, we have established several (currently 17) joint projects with Underwriters Laboratories Inc. (ULI) in the U.S., whereby we jointly develop and publish common CSA/UL *binational* Standards. The first such document, published in 1990, deals with heating and cooling equipment. In fact, that document has been submitted by Canada and the U.S. to IEC and forms the basis of a current IEC draft.

Nearly all of the Information Technology program directly relates to ISO work, and the committees are fully harmonized. SCOT's committees on telecommunications Standards work hand-in-hand with those of the U.S. Standards organizations: the Telecommunications Industry Association (TIA) and the Exchange Carriers Standards Association (ECSA) / American National Standards Institute (ANSI) T1 committee.

Information and Participation

We welcome your participation in developing CSA Standards and urge anyone interested to apply to become a committee volunteer. CSA staff, in consultation with the committee Chairman assess all applications, bearing in mind technical credentials and experience, committee size, membership balance, and affiliation.

Anyone wishing to become involved with a specific committee should contact the Standards administrator concerned, if known, or call me at (416)747-2670. For persons interested only in monitoring committee activity, *information memberships* are available, for a small annual fee.

For enquiries relating to product testing or certification, call Customer Services at (416)747-4007.

For information regarding the availability or purchase of a Standard, contact Standards Sales at (416)747-4044. ■

About the author

Paul Bates is a Professional Engineer with a B.E.Sc. degree from the University of Western Ontario and an M.A.Sc. degree from the University of Waterloo. He has many years of experience; in industry with Electrohome Ltd., in research with Bell-Northern Research, and as a college professor with Sheridan College. While at Sheridan, he wrote a text on data communications, which was published by Prentice-Hall in 1987. Mr. Bates is currently Manager, Electrical, Electronics and Communications Standards with CSA.

THE FIFTH IEEE BIENNIAL CONFERENCE ON ELECTROMAGNETIC FIELD COMPUTATION

FINAL CALL FOR PAPERS

SPONSORS: The IEEE Magnetics Society and Harvey Mudd College.

COOPERATING SPONSORS: The IEEE Education, Microwave Theory and Techniques, and Engineering in Biology and Medicine Societies, IEE London, IEE Japan, IE Australia, Magnetics Society of Japan, IEEE Canada, The Japan Applied Electromagnetics Society, The Applied Computational Electromagnetics Society, The Electromagnetics Academy, The IEEE Los Angeles Council, The Electric Power Research Institute and IBM's Storage Systems Products Division.

VENUE: Harvey Mudd College, Claremont, CA.

DATES: 3rd to 5th August, 1992.

SUBJECTS: All aspects of electromagnetic field computation.

PUBLICATION PROCESS AND DEADLINES:

i) By **21 Feb., 1992** submit a 2-page digest (emphasizing results to show the completeness of work) to the IEEE CEFC Secretariat. All accepted papers (notification by 6 April, 1992) appear in the Conference Digests distributed at the conference.

ii) All accepted authors are invited to submit their full papers by 1 June, 1992, for review under standards prescribed by the IEEE Technical Activities Board for publication in the special CEFC sponsored March 1993 issue of the IEEE Transactions on Magnetics or the February 1993 issue of the IEEE Transactions on Education, as appropriate.

OTHER MATTERS: A free, pre-conference course on introducing computer techniques in the electromagnetics classroom will be conducted for instructors during 30-31 July, 1992. The conference will be followed by the TEAM/ACES Workshop on field computation code-validation during 6-7 August, 1992. Subsidized on-campus housing and air-travel available.

FURTHER ENQUIRIES: From the CEFC Secretariat, Harvey Mudd College, Claremont CA 91711. Tel. 714 - 621 8019; Fax 714 - 621 8465; E-mail: CEFC@HMCVAX.BITNET.

S. Ratnajeevan H. Hoole
General Chairman - IEEE CEFC

Les réseaux électriques au Québec

Formation, concertation et relève

Un forum sur l'enseignement et la recherche dans le domaine des réseaux électriques et de l'électrotechnique s'est tenu en septembre 1991 à Québec dans le cadre du Congrès canadien en génie électrique et informatique, sous le patronage de la Société canadienne de génie électrique et informatique et en collaboration avec IEEE région 7.

Une quarantaine de participants provenant du secteur industriel, du génie conseil, des universités, et des entreprises de génération, de transport et de distribution de l'électricité ont répondu à l'appel de l'organisateur de cette rencontre, le **Dr. Denis Angers**, directeur du Département de génie électrique de l'Université Laval. Ce dernier avait soumis à la réflexion des participants que, malgré l'importance de l'électrotechnique au Québec, on observait dans les universités un certain désintéressement des étudiants pour ce domaine et une insuffisance des fonds disponibles pour la recherche en électrotechnique.

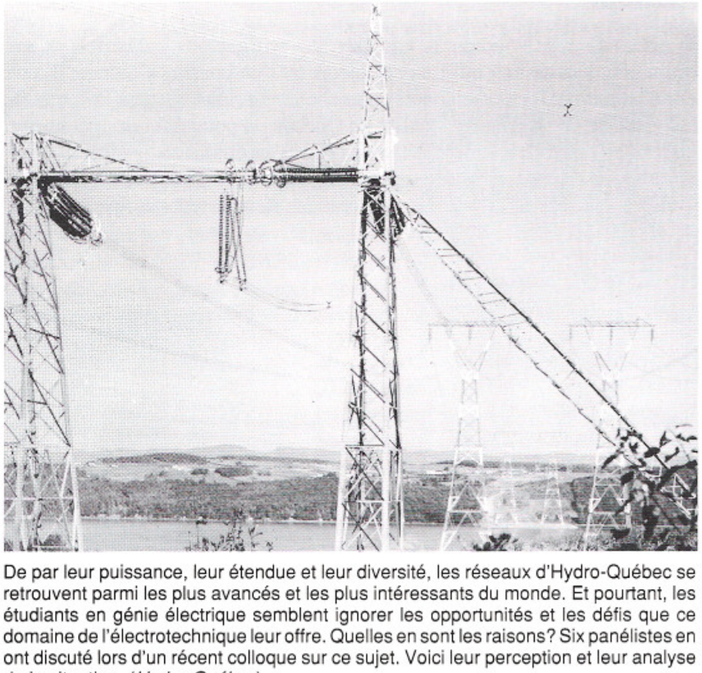
Quatre thèmes étaient proposés aux participants: la relève dans le domaine de l'électrotechnique aux niveaux recherche et enseignement au Québec; l'utilisation des sources de financement de la recherche; la concertation entre les universités québécoises relativement aux projets de recherche et de développement; le degré d'adaptation des programmes d'enseignement en électrotechnique dans les universités québécoises par rapport aux besoins de la société et de l'industrie.

L'électrotechnique est un secteur du génie électrique qui connaît une maturité depuis plusieurs années. Comme résultat, les étudiants lui préfèrent d'autres champs de spécialisation.

Par contre, l'analyse de réseaux électriques présente de nombreux défis découlant des innovations technologiques dans d'autres secteurs. Les participants à cette conférence proposent donc qu'un comité d'experts établisse les meilleures ressources de chacun des centres de formation en électrotechnique et qu'un comité conjoint Industrie-Université identifie les problèmes techniques les plus pressants et en confie l'étude aux équipes les plus qualifiées. Il sera ainsi possible d'intéresser les étudiants à ce secteur et de circonvenir à la pénurie de personnel qualifié anticipée.

Power Engineering is that part of Electrical Engineering that has matured over the years. As a result, students favor other fields.

On the other hand, the analysis of electrical networks still presents challenges, mainly due to innovations in other sectors. The participants of this conference propose that a committee of experts identify the best resources available in Electrical Engineering departments. A joint Industry-University committee would then identify urgent problems and address them to the most qualified research teams. It should then be possible to attract students to the power sector and prevent the shortage of qualified personnel expected in years to come.



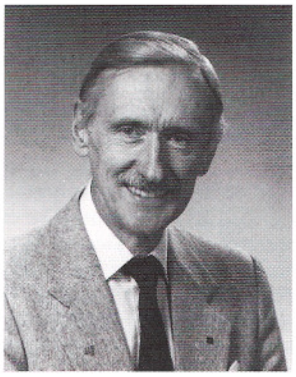
De par leur puissance, leur étendue et leur diversité, les réseaux d'Hydro-Québec se retrouvent parmi les plus avancés et les plus intéressants du monde. Et pourtant, les étudiants en génie électrique semblent ignorer les opportunités et les défis que ce domaine de l'électrotechnique leur offre. Quelles en sont les raisons? Six panélistes en ont discuté lors d'un récent colloque sur ce sujet. Voici leur perception et leur analyse de la situation. *(Hydro-Québec)*

The vast Hydro-Québec power network is among the most advanced and interesting systems in the world. And yet, electrical engineering students seem to ignore the opportunities and challenges that the electric power field offers. What are the reasons behind this attitude? Six panelists discussed the matter at a recent symposium. Here is their perception and analysis of the situation. *(Hydro-Québec)*

Le président du colloque, Raymond St. Arnaud, professeur à l'Université Laval mentionna, d'entrée de jeu, que le problème du désintéressement des universités et des étudiants pour l'électrotechnique n'est pas limité au Québec et n'est pas non plus un problème nouveau, et qu'il existe depuis plusieurs années aux Etats-Unis. Il s'agit là selon lui d'un paradoxe, car l'industrie de l'électrotechnique et de l'énergie électrique est toujours très active et utilise les technologies les plus avançées.

Six panélistes invités exposèrent d'abord leur point de vue sur les thèmes proposés. Il s'agissait de MM. **Yvon Hotte**, Hydro-Québec; **André Dupont**, Asea Brown Boveri; **Guy St-Jean**, IREQ; **Francisco Galiana**, Université McGill; **Jean-Luc Dion**, Université de Québec à Trois Rivières; **Philippe Viarouge**, Université Laval. Voici un résumé de leurs interventions.

Jean-Luc Dion, Université du Québec à Trois Rivières



Jean-Luc Dion est professeur titulaire de génie électrique à l'Université du Québec à Trois-Rivières. Il est diplômé en génie physique de l'Université Laval et détient un doctorat ès Sciences de l'Université Paul-Sabatier de Toulouse. Il fut le premier directeur du Département d'Ingénierie de l'UQTR, de 1969 à 1972. Il y est actuellement responsable du Génie Électrique, après l'avoir été en 1976-1977. Ses activités d'enseignement et de recherche sont principalement dans les domaines de l'électromagnétisme des mesures électriques et de l'ultrasonique appliquée. Pendant plusieurs années, il a été responsable d'une petite entreprise de *R et D* en électronique industrielle. Il est l'auteur de quelque soixante-dix publications diverses et de quatres brevets, dont deux en instance. Il a récemment reçu le prix Benjamin-Sulte de la Société St-Jean Baptiste pour l'ensemble de ses travaux et le prix John S. Bates de l'Association Canadienne des Producteurs de Pâtes et Papiers.

Jean-Luc Dion, résumé du discours

Il semble bien que tous ceux qui sont réunis ici aujourd'hui perçoivent qu'il existe un problème dans le domaine de l'électrotechnique en général et de celui des réseaux de transmission d'énergie en particulier.

C'est un problème hautement complexe, et le flottement qui l'entoure risque de compromettre l'essor de notre mission qu'on pourrait dire naturelle dans le domaine de la production et de l'exploitation de l'énergie hydro-électrique. Or, le simple bon sens nous indique le péril qui nous menace en négligeant ce secteur vital de notre économie.

Il faut dire que cette préoccupation est assez générale en Amérique du Nord depuis plusieurs années. Effectivement, ce n'est pas d'aujourd'hui qu'on remarque un désintéressement assez massif des étudiants vis-à-vis la spécialisation en électrotechnique.

Une exception à la régle semble être l'Université d'Illinois d'Urbana-Champaign où les inscriptions et les activités sont en hausse depuis 1986. Il semble que cet essor est lié à une attitude nouvelle devant l'électrotechnique et à la modernisation de l'approche. On a trouvé divers moyens pour intéresser les étudiants, on a multiplié des contacts avec les gens de l'industrie.

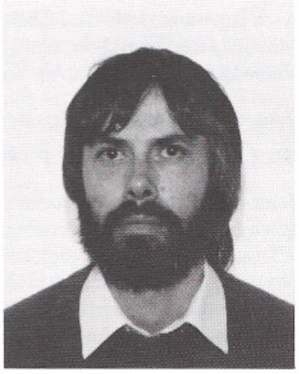
Justement, on a constaté qu'il y a problème si on adopte une vue conventionnelle et restrictive du champ de l'électrotechnique, si on le limite aux machines électriques et aux lignes électriques classiques. Or, l'électrotechnique **peut** et **doit** être modernisée. L'ingénieur dans ce domaine doit être polyvalent. Il doit connaître l'électronique de puissance, les méthodes de fabrication, les ordinateurs, les finances, et les méthodes de planification.

Dans le domaine de l'électrotechnique, il y a une multitude de problèmes qui peuvent être résolus en faisant appel à des techniques modernes. Par exemple, on peut faire le contrôle de l'huile de transformateur par ultrasons pour déceler la présence d'eau et de gaz, et ainsi déterminer le champ disruptif.

Malheureusement, il y a une foule de projets innovateurs qui dorment, faute de crédits pour la recherche et le développement. Une foule de projets dont la réussite contribuerait certainement à ranimer à la fois l'enseignement et la recherche dans nos universités et qui contribuerait aussi à l'innovation dans nos industries. Je n'ai pas à vous convaincre que la réussite économique d'un peuple passe par l'innovation, le travail, la concertation et le dynamisme. Et nous ne pouvons pas échapper à cette règle au Québec.

Il est par conséquent naturel que nous soyons réunis ici aujourd'hui pour en parler. Mais il faudra que cette rencontre soit suivie d'autres qui nous permettront de mettre en oeuvre cette nécessaire concertation, si l'on souhaite vraiment des résultats. C'est devenu une question vitale pour notre avenir.

Philippe Viarouge, Université Laval



Philippe Viarouge est professeur au département de Génie Electrique de l'Université Laval depuis 1979, où il dirige en collaboration avec le Dr. Le-Huy et le Dr. I.Kamwa, le laboratoire d'Electrotechnique, d'Electronique de puissance et de Commande Industrielle (LEEPCI). Il a obtenu son diplôme d'ingénieur, option Electrotechnique Automatique, de l'ENSEEIHT à Toulouse (France) en 1976, et son diplôme de Docteur Ingénieur, option Electrotechnique, de l'institut National Polytechnique de Toulouse en 1979. M. Viarouge s'intéresse à la conception, la modélisation et l'identification des machines électriques, à la commutation électronique dans les machines électriques, à l'électronique de puissance et à la commande des entraînements à vitesse variable.

Philippe Viarouge, résumé du discours

Je voudrais alimenter ce débat par quelques réflexions très personnelles sur les questions qui sont posées, à partir de mon expérience d'enseignant et de chercheur en Électrotechnique.

Tout d'abord, la clientèle étudiante au premier cycle dans le secteur de l'électrotechnique est faible, de l'ordre de 10 % des étudiants en génie électrique. Les 23 chercheurs en formation au laboratoire sont à 70% des étudiants étrangers, dont la plupart retourneront chez eux à la fin de leurs études.

La relève des professeurs et des chercheurs en électrotechnique est en péril compte tenu du faible nombre de gradués québécois dans le domaine. Ceci est dû en particulier à l'octroi de bourses trop peu nombreuses et de montant insuffisant.

Jusqu'à récemment, notre laboratoire LEEPCI s'occupait principalement de la recherche sur la conception et la modélisation des machines électriques à commutation électronique, la recherche sur les convertisseurs statiques, et la commande industrielle.

Pour adapter ses activités aux besoins du milieu, le laboratoire a depuis un an défini un nouveau plan d'orientation dans le domaine du contrôle dynamique des réseaux. Cette initiative a coïncidé avec la mise sur pied d'une entente de collaboration avec le Service simulation de réseau d'Hydro Québec. Il se traduit par une standardisation des outils de travail, le prêt de matériel et de logiciels, et le support pour la formation de chercheurs sous forme de bourses d'études.

Il faut signaler que la réorientation des activités de recherche ne constitue pas une remise à zéro, puisque nous avons pu identifier un nombre important de domaines et de projets de réseaux où l'expérience des chercheurs du LEEPCI peut être mise à profit.

Compte-tenu du faible nombre de professeurs concernés, il paraît évident qu'une concertation des universités est indispensable, si l'on veut résoudre efficacement les problèmes. Pour la même raison, elle est possible, puisqu'il n'y aura pas beaucoup de personnes autour de la table.

Je veux saisir l'occasion pour signaler l'inadaptation du contenu du programme d'enseignement à la réalité de l'électrotechnique moderne qui est devenue un domaine multidisciplinaire, où l'automatique, le traitement de signal, le génie informatique et l'électronique de puissance ont révolutionné les concepts.

En conclusion, je voudrais m'adresser aux participants industriels de ce forum pour leur assurer qu'il existe encore (et l'on pourrait s'étonner d'une telle obstination!) des enseignants et des chercheurs motivés dans le domaine de l'électrotechnique et qu'il existe au Québec un potentiel insoupçonné et inutilisé de compétences intellectuelles parmi les étudiants. Il suffirait d'un minimum de concertation et de support logistique pour utiliser ces ressources efficacement afin d'affronter les défis industriels et technologiques de la société Québecoise.

Francisco Galiana, Université McGill

Francisco Galiana est gradué de l'Université McGill où il a obtenu son B. Eng. en génie électrique avec honneurs, en 1966. Il a ensuite obtenu son doctorat de MIT en 1971. Il a poursuivi des recherches au Centre de recherche Brown Boveri, en Suisse, et à l'Université de Michigan. Depuis 1977 il est professeur en génie électrique à l'Université McGill. Sa spécialité est dans le domaine de la planification et le fonctionnement des réseaux électriques, y compris les systèmes experts, l'analyse de la répartition optimale du transport de l'énergie, la remise en marche d'un réseau, la simulation des réseaux par ordinateur, la prédiction et la gestion des charges, le calcul symbolique, et la planification des calendriers d'opération des centrales hydrauliques-thermiques.

Le professeur Galiana s'intéresse beaucoup au transfert de la technologie et de son expérience pratique à ses étudiants.

Dr. Galiana est membre senior de l'IEEE, membre de la Sigma XI et, en1991, il était le Président exécutif de la Conférence PICA de l'IEEE.

Francisco GALIANA, résumé du discours

Dans les universités, l'électrotechnique est en situation de crise, particulièrement dans la spécialisation des réseaux électriques: les professeurs ne sont pas remplacés, et les meilleurs étudiants évitent le domaine pour aller plutôt dans l'informatique et l'électronique.

En effet, l'image de l'électrotechnique est ternie: les étudiants la percoivent comme un sujet désuet et pas moderne. Cette situation est attribuable en partie à une baisse du nombre d'emplois offerts dans le domaine du courant fort, ce qui produit un impact très négatif chez l'étudiant.

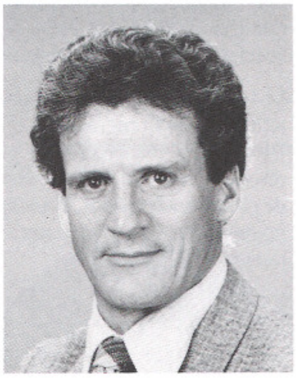
En 1987, l'industrie électrique embauchait au Canada un total d'environ 100 000 personnes. Les 20 universités offrant des cours en électrotechnique comprenaient une soixantaine de professeurs et formaient environ 300 gradués par année. Cependant, la moitié étaient des étudiants étrangers qui sont retournés dans leur pays d'origine. La situation est sensiblement la même aujourd'hui. C'est dire, que si l'industrie veut subitement embaucher des étudiants en puissance, ils ne seront pas là. Il ne faut pas oublier que ça prend entre 5 et 7 ans pour former un ingénieur. Le problème est que l'on ne peut pas embaucher un finissant en informatique pour résoudre des problèmes de réseau.

À mon avis, on devrait moderniser les programmes d'enseignement en utilisant davantage les ordinateurs dans les programmes en électrotechnique. Mettre davantage l'accent sur la conception et l'analyse que sur les tâches ennuyantes et répétitives. À ce propos, il est primordial d'encourager des projets industrie-université. De cette manière, l'industrie de l'électrotechnique pourrait attirer les meilleurs étudiants, par l'offre de bourses et d'emplois d'été. Je suis content que Hydro-Québec offre aujourd'hui une quinzaine de bourses substantielles pour les étudiants poursuivant des études en électrotechnique au niveau de la maîtrise.

Enfin, il est remarquable que le gouvernement fédéral n'ait pas encore créé un seul centre d'excellence en électrotechnique, alors que le besoin est évident. L'Association Canadienne de l'électricité (ACE), pourrait jouer un rôle très important dans la résolution de cette problématique, et je suis persuadé que c'est un sujet qui la préoccupe.

Enfin, je suis heureux que ce colloque permette d'identifier les points principaux, en vue de trouver des solutions.

Guy St-Jean, IREQ Hydro-Québec



Guy St-Jean est né à Montréal au Canada. Il a obtenu ses diplômes de B.Sc. et M.Sc. en physique en 1964 de l'Université Concordia et 1977 de l'Université du Québec CERV. Entré à Hydro-Québec en 1965, il est actuellement chef de service de recherche en appareillage à l'IREQ et est responsable du développement de nouvelles technologies pour la recherche et le développement d'appareillage de puissance. Il est Fellow de l'IEEE, président canadien des comités techniques CEI 17 sur l'appareillage et CEI 37 sur les parafoudres, membre CIGRE du comité d'étude 13 sur l'appareillage, et membre du Research Manager's Forum du Canada. Il est auteur/co-auteur de plus de 50 publications internationales et a gagné à deux reprises le "Prize Paper Award" du Power Engineering Society (PES) de l'IEEE.

Guy St-Jean, résumé du discours

Je suis d'accord qu'il y a une baisse d'intérêt et une baisse de financement conventionnel dans le domaine de l'électrotechnique. Mais la société est en voie de passer d'une société centralisée à une société d'économie et les universitaires voient le système ancien plutôt que le système nouveau et craignent le Déclin de l'Empire Électrotechnique.

La vraie solution à tout cette problématique est dans la recherche d'entrepreneurs. Il manque d'entrepreneurs. Les universités ne génèrent pas des entrepreneurs qui sont capables de prendre leur mallette et aller chercher des contrats de R et D.

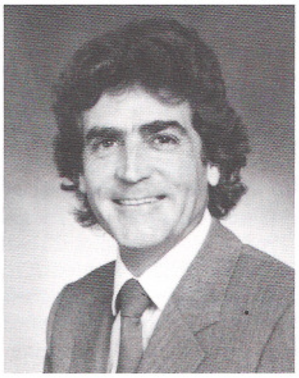
À l'IREQ, récemment on nous a donné la moitié seulement des ressources financières dont nous avions besoin; la balance, il a fallu aller la chercher chez des clients. Nous avons bien réussi dans ce contexte. Mais, il a fallu que les gestionnaires deviennent entrepreneurs pour trouver les argents et des projets intéressants pour les membres de leur équipe. Tout ceci s'est réalisé en 1990 après une année de rodage et en plus beaucoup de sous-traitance a été donnée à des fournisseurs extérieurs par l'IREQ. Ces contrats soulèvent la question de la confidentialité de l'information. En effet, les universités doivent assurer la confidentialité des travaux de R et D effectués pour les entreprises clientes.

Pour ce qui est de la formation, ce n'est pas seulement le milieu académique qui forme les gens, mais aussi le milieu de travail.

Les professeurs qui m'ont précédé ont parlé d'électronique de puissance et de systèmes de contrôle, je crois qu'ils sont rendus sur la bonne voie. Le gros matériel, les transformateurs, les génératrices, etc., ont atteint un stade de maturité, de sorte que leur design change assez lentement et ne devrait pas être l'objet de recherche des universités. On arrive à une époque où ce sont les contrôles qui vont réduire le poids, le volume et le coût de l'appareillage et en augmenter la fiabilité.

Les systèmes de contrôle et d'intelligence artificielle sont une nouvelle pointe de la technologie. On a aussi besoin de traitement numérique et de traitement d'images, lesquels sont utilisables dans tous les domaines de la science - et vos étudiants excellent dans ces domaines. Les éléments finis sont une autre niche qui s'applique partout - en mécanique, en thermodynamique, en électronique. Quant au gros matériel - les transformateurs, les génératrices et l'électrotechnique classique, l'industrie pourra l'enseigner aux étudiants gradués. Donc il est suggéré aux chercheurs universitaires de ne pas s'attarder à l'ancienne technologie mais à développer plutôt aux nouvelles technologies de contrôle. En électrotechnique, c'est la finesse de contrôle de l'appareillage de puissance qui va dessiner notre avenir.

André Dupont, Asea Brown Boveri



André Dupont a terminé ses études d'ingénieur à l'Université Laval en génie électrique en 1959, et y a obtenu une Maîtrise en sciences appliquées en 1965. Il a fait aussi des études post-graduées à McGill, dans le cadre d'un programme conduisant au M.B.A.

M. Dupont a fait carrière principalement à Hydro-Québec, dans les réseaux à haute tension à 315 kV, en exploitation, essais et protection. Il a été un des principaux ingénieurs chargés des essais de réception du réseau 735 kV. Il a été un des fondateurs de l'Institut de Recherche d'Hydro-Québec où il devint Directeur, Grande puissance.

M. Dupont a fondé les entreprises Dupont Bouchard et Associés, Création 2000 inc. et sa propre entreprise A. Dupont et Associés inc.

Depuis mai 1991, il est Directeur de la Recherche et du développement chez ABB, Asea Brown Boveri.

André DUPONT, résumé du discours

Depuis les années '60, l'électrotechnique a pris un essor flamboyant au Québec grâce au développement des ressources hydroélectriques. Ceci a été une locomotive pour l'industrie.

Aujourd'hui, les besoins en énergie sont toujours là, mais son utilisation est plus rationnelle. Les besoins d'optimisation se font sentir aux plans technique, économique et écologique. Beaucoup d'innovations sont requises pour optimiser les installations existantes, interrelier les réseaux de façon dynamique, gérer différemment la demande, commander les réseaux de façon interactive par des systèmes complexes et décisionnels.

Dans ce contexte, le besoin d'ingénieurs et de chercheurs en électrotechnique est évident. Asea Brown Boveri à elle seule compte 1300 employés au Québec, dont une centaine d'ingénieurs.

Pour assurer une meilleure formation des ingénieurs, les contacts permanents université-industrie sont essentiels. Il serait souhaitable que les professeurs effectuent des séjours dans l'industrie, et que les ingénieurs de l'industrie participent à l'enseignement. Une osmose est nécessaire entre les futurs employeurs d'ingénieurs et les formateurs d'ingénieurs. Il doivent travailler ensemble à des programmes d'enseignement adaptés à la réalité d'aujourd'hui. En particulier, on doit favoriser les projets multidisciplinaires pour partager les connaissances et les ressources.

En ce qui concerne les étudiants finissants, la grande entreprise prévoit des stages d'entrainement . Ces stages ont une durée pouvant varier de 6 mois à 2 ans. Le but de ces stages est de familiariser le nouvel ingénieur avec les produits de l'entreprise et connaître le fonctionnement de l'entreprise. Dans le cas de ABB, les stages durent 2 ans, répartis en quatre périodes de 6 mois dans des divisions différentes.

Pour la recherche et le développement, une concertation est aussi nécessaire: l'université a la matière grise et l'industrie a des besoins et de l'équipement disponible. Les argents pour la R et D sont là, il faut s'organiser pour aller les chercher en présentant des projets concrets. De son côté, ABB veut développer sa recherche au Canada avec les universités et les centres de recherche existants. Une partie du financement de R et D serait possible au moyen de consortiums formés de différentes industries.

Il serait souhaitable que chaque université se spécialise dans un secteur particulier de l'électrotechnique, afin d'éviter la dispersion des forces et de jouir chacune d'équipements de laboratoire plus modernes. Une table de concertation entre les universités apporterait une grande crédibilité dans le public et dans les organismes subventionnaires. Une concertation entre universités est souhaitable, compte tenu des investissements requis, et des centres d'excellence doivent être définis dans chacune d'elles.

Je propose donc que l'on forme le plus tôt possible, un groupe de travail pour élaborer une stratégie de concertation et de coopération entre les universités et l'industrie.

Yvon HOTTE, Hydro-Québec

Yvon Hotte est gradué de l'École Polytechnique de Montréal où il a obtenu un diplôme de Baccalauréat en 1968 et de Maîtrise en ingénierie en 1974. Depuis 1968, il est à l'emploi d'Hydro-Québec, oeuvrant à la planification du réseau où il a accumulé une vaste expérience dans ls domaine de l'analyse de comportement de réseau et de l'équipement. Il est présentement Chef de service, Études de réseau.

Yvon HOTTE, résumé du discours

Je constate qu'il y a un accord général sur le diagnostic de la situation en ce qui concerne l'électrotechnique. Comme je suis un gestionnaire à la vice-présidence Planification du réseau d'Hydro-Québec, j'aimerais d'abord rappeler que les besoins d'Hydro-Québec en matière de savoir-faire sont en relation directe avec sa mission, laquelle est de fournir l'électricité aux Québécois et d'optimiser l'avantage comparatif que constitue l'hydro-électricité. Cette mission découle de la politique énergétique du Gouvernement de Québec, dont un des objectifs est de stimuler le développement économique et d'appuyer le développement régional, tout en protégeant l'environnement et la qualité de vie.

Hydro-Québec doit donc développer un très vaste réseau de production et de transport. Il faut chercher les ressources les plus rentables là où elles se trouvent. Le projet Grande Baleine est à 1200 km de Montréal. Il faut donc un réseau de transport dont la longueur est au moins 1200 km. Churchill Falls aussi est à 1200 km, mais dans une direction complètement opposée. Donc, on doit développer un réseau de transport très vaste, à des tensions élevées, avec des postes de transformation comprenant des centaines d'appareils, plus les systèmes de commande, automatismes, etc.

Cela demande des ingénieurs capables d'intégrer tout un ensemble de concepts, possédant une vision globale des choses. En particulier, on doit respecter la cohérence et l'intégrité du réseau. Sur le plan technique, ces besoins demandent une connaissance et une maîtrise du comportement d'ensemble d'un vaste réseau d'éléments interconnectés dont les interactions peuvent être très nombreuses et très complexes. Un réseau électrique est assimilable à un circuit électronique de grande envergure. Ce réseau extrêmement puissant véhicule des milliers d'ampères à des centaines de kilovolts, dans un ensemble qui est fortement intégré s'étendant sur des milliers de kilomètres.

Les études requises pour évaluer le comportement d'un tel réseau dépassent largement les cadres traditionnels de ce qu'on appelle l'électrotechnique. On a souvent tendance à voir ce dernier comme une spécialité qui se limite à l'étude de l'équipement sur une base individuelle. Mais l'étude d'un réseau comme celui d'Hydro-Québec implique plutôt l'interaction entre les équipements à l'intérieur d'un système intégré. En effet, c'est l'ingénierie des systèmes.

On doit donc connaître les concepts régissant la stabilité des alternateurs, la coordination de l'isolement des équipements, la propagation des ondes de haute tension, les phénomènes de résonance, la coordination des systèmes de commande, la production et la propagation des harmoniques, les phénomènes d'interférence avec le milieu ambiant etc. À cela s'ajoutent systèmes experts, systèmes asservis, automatismes, électronique de puissance, moyens sophistiqués de compensation, etc.

Incontestablement, c'est de la haute technologie. L'électrotechnique moderne est donc un domaine apte à susciter l'enthousiasme de tout étudiant en génie électrique.

Conclusion

Ce forum remarquable sur l'électrotechnique a permis l'échange des points de vue de l'industrie (y compris Hydro-Québec) et ceux des universités. L'industrie souhaite que l'enseignement universitaire en électrotechnique soit davantage orienté vers la conception de systèmes, la multidisciplinarité, et les principes fondamentaux. Elle pense aussi que les programmes d'enseignement et les recherches doivent miser sur les systèmes de commande, plutôt que sur la préoccupation traditionnelle pour les machines électriques dont la technologie a atteint un stade de maturité. Enfin, on doit reconnaître que l'industrie prend souvent sur elle la tâche de compléter la formation spécialisée des gradués universitaires.

Le forum a révélé que l'industrie désire collaborer avec les universités, tant au niveau des programmes d'enseignement que des projets de recherche. Bien sûr, la recherche doit porter sur les problèmes que l'industrie doit résoudre, mais ils sont tellement nombreux que l'on ne sera jamais à court de projets intéressants. Toutefois, il faudra que les chercheurs universitaires fassent preuve de leur compétence dans le secteur particulier où ils désirent oeuvrer.

Les participants ont convenu qu'une concertation s'impose au sein des différents départements de génie électrique de façon à identifier d'abord, puis à mettre en évidence, les meilleures ressources de chacun. De plus, on convient de mettre sur pied un comité conjoint employeurs-universités, lequel aura pour mission d'identifier les problèmes techniques les plus immédiats dans le secteur, et d'en confier l'étude à certaines équipes sélectionnées par lesdits départements.

Le forum a été un franc succès. Il a démontré que la vision traditionnelle de l'électrotechnique doit être modifiée, et que l'industrie ne demande pas mieux que de collaborer davantage avec les universités, tant pour la participation à l'enseignement que pour le financement de la recherche orientée. ■

Design and comparison of energy efficient electric motors

Electric motors greater than one horsepower consume over half the electrical power generated in North America. Consequently they also represent a major portion of the cost of producing goods on this continent. For example, one 50 hp (~ 37.5 kW) motor operating continuously with an electrical cost of $.057/kW·h will cost over $20 000 to operate during the first year. Over a ten year life span that figure jumps to $200 000! As a result, there is a determined effort on the part of motor manufacturers to develop and produce more efficient motors to meet the industrial needs of Canada and the United States. The first generation of energy efficient motors were commonly called "high efficiency" motors. Improvements were made to these motor designs to meet the increasing demands of industry and the latest generation of motors with the best efficiency values are now referred to as "premium efficiency" motors.

But what makes one motor more efficient than another? How can motor efficiency be measured? And how should energy efficient motors be compared? This article will attempt to address these issues and lend some sense to what can be a confusing problem for many users of industrial motors.

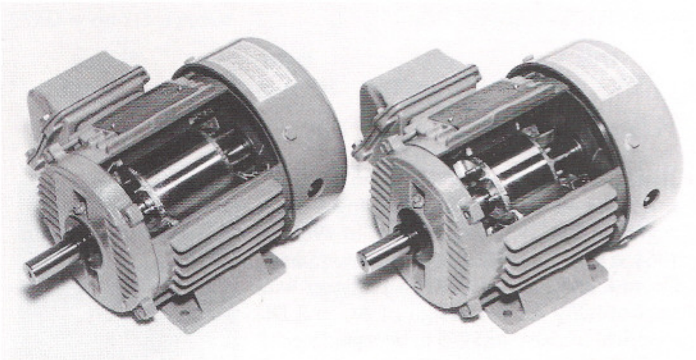


Figure 1: Energy efficient motor (on the left) versus standard efficiency motor (on the right), cut away to show the extra material in the energy efficient motor.

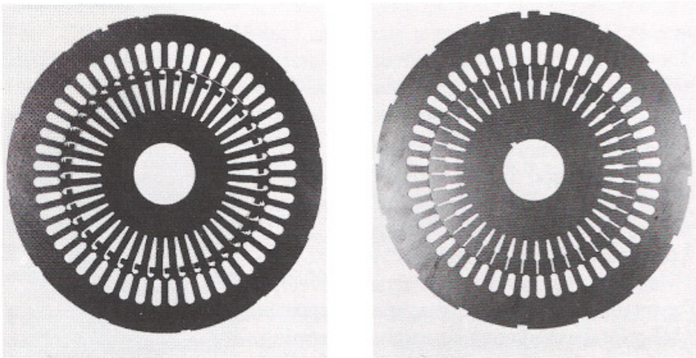


Figure 2: The stator and rotor laminations from a premium efficiency EEMAC/NEMA 280 frame 4 pole motor (left) and from a standard efficiency EEMAC/NEMA 280 frame 4 pole motor (right). The major differences between these two sets of laminations, which can be seen in the photographs, are the larger size of the stator slots and the redesigned and optimized rotor slots of the premium efficiency motor.

By James H. Wilson, Member IEEE
Senior Design Engineer - Component Motors
General Electric Canada, Peterborough, Ontario

James C. Hirzel, Manager - Energy $aver Program Development, GE Motors, Fort Wayne, Indiana

Measurement of Efficiency

Motor efficiency could be determined by measuring motor output on a dynamometer and the electrical input in watts and dividing the two as given by the equation:

$$\text{Motor Efficiency} = \frac{746 \times \text{horsepower output}}{\text{watts input}}$$

However, because the motor output is difficult to measure accurately, the accepted standards determine motor efficiency by measuring motor losses. This is expressed as follows:

$$\text{Motor Efficiency} = \frac{\text{watts input} - \text{losses}}{\text{watts input}}$$

It will be recalled that 1 horsepower = 1 hp ~ 746 watts = 746 W.

Motor Losses

When developing energy-efficient motors (Figure 1), the objective of the motor design engineer is, of course, to minimize losses. These losses can be broadly grouped as fixed losses and load losses. They are listed in Table 1 with some representative percentage values.

TABLE 1

Losses	% of total losses
Fixed losses	
windage and friction	14 %
core loss (iron losses)	16 %
Losses varying with load	
stator I^2R loss (copper loss)	33 %
rotor I^2R loss (copper loss)	15 $
stray load loss	22 %
Total losses	100 %

Core loss is the magnetic loss in the lamination steel and is a combination of hysteresis and eddy current losses.

Stray load loss is a combination of high frequency losses caused by harmonic and circulating currents induced by the load current. Some of the factors which contribute to stray load loss are: number of stator and rotor slots, slot geometry, air gap length and various manufacturing processes, especially as regards the rotor.

Designing for Higher Efficiencies

The basic techniques which the motor design engineer uses to reduce losses and therefore optimize the efficiency of motors are as follows:

- Improved rotor/stator steel properties
- Thinner laminations
- Increased magnetic core length
- Increased wire volume
- Optimized slot and rotor end ring designs
- Improved rotor insulation systems
- More efficient fan design

Standard efficiency motors typically use a low carbon lamination steel which has a loss of approximately 6.6 watts per kilogram. To reduce electrical hysteresis and eddy current losses, manufacturers build premium efficiency motors with high grade silicon steel. This steel has a loss of about 3.3 watts per kilogram and costs approximately 50% more than low carbon steel. Additionally, for a steel price premium, the surface of the silicon steel can be given a special insulating surface coat to provide higher interlaminar resistance to eddy currents.

The volume of copper wire in a premium efficiency motor is typically increased by 35% to 40%. This reduces I^2R copper losses in the stator winding. It also requires an increase in slot size by as much as 50 percent. To compensate for the increased slot size and corresponding decrease in active magnetic steel, the motor's stator and rotor cores are lengthened (Figure 1).

Through improved design of the rotor slots and by increasing the conductor cross section (Figure 2), rotor losses can be reduced. Careful selection of slot and end ring size and shape must be made to maintain EEMAC/NEMA* Design B torques and locked rotor currents at their desired values. To minimize the losses from inter-bar currents, the raw punched edges of the rotor slots can be treated with an inorganic insulation before casting.

The lower electromagnetic losses in a premium efficiency motor results in a cooler operating motor. Consequently, the motor does not require the same external cooling as does a standard efficiency design. This allows a smaller fan to be used to provide cooling. Besides reducing windage losses, the smaller fan operates more quietly, offering a nice side benefit.

From the foregoing it is obvious that energy efficient motors, with their significantly increased amounts of material, weigh more and cost more than their standard efficiency counterparts. A 50 hp motor, for example, typically might weigh 7.5% more and cost 25% more. However, both standard and premium efficiency motors of the same rating are built into the same physical package, i.e. EEMAC/NEMA frame size. Therefore standard motors can usually be replaced with higher efficiency motors.

With carefully optimized designs the power factor of premium efficiency motors can be maintained or even improved over standard motors. Energy efficient motors almost always operate at a lower temperature rise than standard motors. Since temperature plays a large part in the aging of motor insulation and bearing greases, energy efficient motors normally can be expected to have a longer life, when operating under the same environmental conditions.

** EEMAC is the Electrical and Electronic Manufacturers Association of Canada. NEMA is the National Electrical Manufacturers Association (USA). Each organization publishes a Motor and Generator standard - MG 1, which sets down standards for dimensions, nameplate markings, performance, etc.*

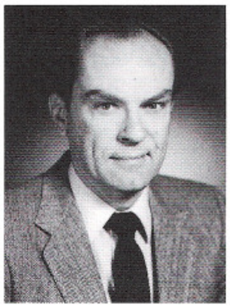
Both standard efficiency and premium efficiency motors are widely available in the 1 hp to 200 hp (~ 0.75 kW to 150 kW) range. They are less commonly available above and below that range. As motors increase in size they become temperature limited. Losses must be kept low to prevent overheating of the insulation system. Consequently, the difference in efficiency values between standard and premium efficiency motors declines dramatically as the horsepower increases.

Comparing Energy Efficient Motors

For a particular motor rating, the nominal (or quoted) efficiency values reflect the statistical arithmetic mean of a large population of motor tests . Because this nominal value is an arithmetic mean, the user may receive a motor with an efficiency above or below the nominal value. Consequently, the expected annual or life-cycle savings calculations can deviate from the actual operational savings. To reduce the discrepancy due to this type of deviation, the user should demand *guaranteed minimum efficiencies* from the manufacturer. The guaranteed minimum efficiency is a statistical value which states that the efficiency for that particular rating has a 99.6% probability of exceeding the guaranteed minimum value. While this value is conservative, it improves the accuracy of the financial evaluation. It also discourages casual efficiency claims by manufacturers and provides the user with a basis for rejection if the motor doesn't meet the minimum value.

When comparing the efficiencies of two motors, it is important that the user employ the same basis of comparison. The motor must be of comparable design, and efficiencies should be determined by the same test method. Both CSA C390 (*Energy Efficiency Test Methods for Three-Phase Induction Motors*), and IEEE 112, Method B (*IEEE Standard Test Method for Polyphase Induction Motors and Generators*) are recommended standards in North America. Other test methods such as the IEC 34.2 or JEC 37 may give significantly higher efficiency values because of a less conservative approach in their treatment of stray load losses. Once the user has determined that a valid comparison can be made, he can calculate the annual or life-cycle savings by using the annual hours of operation, the motor load, the electric tariff and the efficiencies of the two motors. ■

About the author



James H. Wilson attended Queen's University in Kingston, Ontario, receiving a B.Sc. degree in Electrical Engineering in 1961. In 1964 he joined the Prestolite Company in Sarnia, Ontario, and became Design Engineer with responsibility for the design of AC and DC electrical motors. In 1975 he accepted a position with General Electric Canada, where he is now Senior Design Engineer, Component Motors.

About the author

James C. Hirzel graduated from Cal Poly - San Luis Obispo in 1977 with a B.S. degree in Industrial Technology. He has been involved in the motor industry for 14 years, the last 10 years with General Electric Company. As Manager - Energy $aver Program Development in Fort Wayne, Indiana, he has responsibility for the marketing, research, engineering and manufacturing of GE Motors' Energy $aver product line, ranging from 1 to 800 horsepower in various speeds, enclosures and voltages.

Savings and other benefits of energy efficient motors

by R.I. (Cy) Savard, Technical Advisor
in collaboration with
Theodore Wildi, P. Eng.

Energy efficient motors can produce substantial savings during their service life. This article describes four equivalent ways of evaluating these savings, taking into account efficiency, hours of operation, potential price increases and inflation.

Les moteurs électriques à haut rendement peuvent représenter des économies d'énergie importantes au cours de leur vie utile. Le présent article décrit quatre façons d'évaluer ces économies en fonction de l'efficacité, des heures de fonctionnement, des hausses de coûts énergétiques possibles et de l'inflation.

Motor designers and manufacturers have produced many generations of motors, constantly refining the art of motor design concepts, improving motor performances, changing motor appearance and packaging. But fundamentally, the induction motor has not changed over the years; it still relies upon the interaction of magnetic fields to produce torque and power!

Over the last ten years, due to a growing concern and demand for electrical energy savings, motor designers utilizing new energy-efficient materials and special manufacturing techniques, have developed and produced a generation of energy efficient polyphase induction motors in sizes ranging from 1 to 200 horsepower (~ 0.75 kW to 150 kW). The motors convert approximately 85 to 96 percent of their electrical power input into mechanical power output.

TABLE 1
COMPARISON OF TYPICAL EFFICIENCY AND POWER FACTOR VALUES

STD = standard motor *E.E. = energy efficient motor*

load (%)		100%		75%		50%	
hp	**type**	**eff'cy**	**P.F.**	**eff'cy**	**P.F.**	**eff'cy**	**P.F.**
1	E.E.	84.0	80.5	84.0	74.0	81.5	62.0
1	STD	72.0	78.0	72.0	70.0	68.0	58.0
10	E.E.	90.2	88.0	90.2	85.0	90.2	77.0
10	STD	84.0	85.5	84.0	80.5	81.5	75.0
50	E.E.	92.8	84.5	93.0	81.0	91.7	73.0
50	STD	91.7	84.0	91.7	81.0	90.2	71.5
100	E.E.	93.5	91.5	94.0	91.0	93.8	87.0
100	STD	91.7	83.5	91.7	80.5	90.2	73.0
200	E.E.	94.8	90.5	95.0	88.5	94.6	83.0
200	STD	93.0	88.5	93.0	86.5	91.7	80.0

The "Energy Efficient Motor" represents a proven technology, recommended for use in most commercial, institutional and industrial applications. Energy efficient motors are physically and mechanically interchangeable with standard T frame motors. Table 1 gives typical efficiency and power factor values for the two types of motors. The efficiency of energy efficient motors is generally improved by an estimated 2 to 9 percentage points, ranging from 2% at 200 hp to 9% at 1 hp. Although the percentage improvement in efficiency becomes smaller as the power increases, a 2 percentage point improvement for a 200 horsepower motor produces a substantial 3.4 kW demand saving.

Power factor is also generally improved. Mōtor efficiency, power factor and price vary significantly among designs and manufacturers. The price premium for energy efficient motors is estimated at 20 % to 30 % in the lower horsepower range, and 5 % to 10% in the higher horsepower range.

It is estimated that the annual operating cost of an induction motor running continuously at full load is equivalent to 4 to 5 times its capital cost. Given a 100 hp standard motor having a 91.7% efficiency, an estimated average price of $6000, and operating at an average electricity rate of 5 ¢/kW·h, the estimated annual operating cost is over $ 35 000.

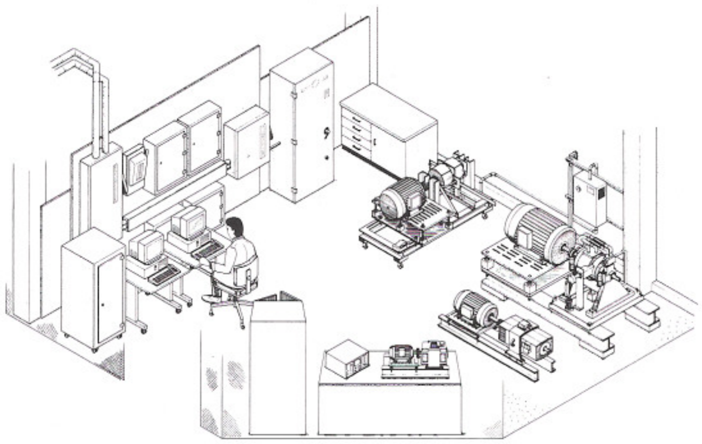
The choice of selecting a high efficiency motor over a standard motor is usually based on the payback period for the extra capital investment. In calculating payback, several factors must be considered: (1) motor power and motor loading, (2) hours of operation, (3) cost of electricity (actual and estimated future cost), (4) improved power factor, and (5) potential released system capacity (kVA). Of these, the first three are the most important.

Electric motor performance is directly affected by applied voltage conditions. The effects of voltage variations, voltage drops at motor terminals, phase imbalance and frequency variations can cause motor losses to go up and efficiency to drop.

Nominal efficiency values shown on the motor nameplate or published by motor manufacturers are only valid for motors operating at rated sinusoidal voltage and frequency as stamped on the nameplate. Variations from nominal ratings could change the anticipated savings and therefore should be considered in a complete financial analysis.

Since the performance of high efficiency motors is often measured against that of standard motors, it is important that identical terms and testing standards be used when comparing and performing an economic analysis. All efficiency figures used for comparison should be based on the same test method and identified as either "quoted" or "nominal" values. Nominal values reflect the statistical arithmetic mean of a large population of motors, tested for a particular motor rating. The full-load guaranteed minimum efficiency is a more conservative value. It is often used in payback calculations because it ensures greater certainty of the expected financial benefits.

All motor efficiency values must be determined and tested in accordance with CSA C390-M1985 or IEEE 112 B motor efficiency testing standards. Both methods are considered as equally acceptable.



The efficiency of electric motors in the 1/4 to 200 horsepower range can be objectively measured in the independent test facility at **ORTECH International**, located in Mississauga, Ontario. Principal customers of the electromotive facility, which also evaluates motor drive systems, are motor manufacturers, utilities, companies and electric motor rewind shops.

A similar test facility having a capacity of up to 375 kW (500 hp) will soon be operational in **Hydro-Québec's LTEE Laboratory** (Laboratoire des technologies électrochimiques et des électrotechnologies) in Shawinigan.

Rebate programs

Some Canadian electrical utilities offer a motor rebate program. It is designed to encourage motor buyers to purchase energy efficient motors by paying part of the cost differential between energy efficient and standard models.

All participating utilities use the same Motor Efficiency Levels as qualifying criteria. Motors that meet the qualifying levels are eligible for rebate in those provinces where a rebate program exists. Utilities employ different rebate criteria, typically dollars per horspower over a fixed threshold, or dollars per kilowatt saved on a sliding scale. The higher the efficiency the higher the rebate.

In general, incentive programs apply to the purchase of replacement motors or the addition of new equipment.

Methods of calculating savings

The first step in any economic analysis is to estimate the potential savings to be had by installing an energy efficient motor instead of a standard motor. Let us review the steps involved in making such a financial analysis:

1 - Calculate the energy savings (kW·h)

2 - Calculate the power savings (kW)

3 - Calculate the annual electricity savings ($)

4 - Assess the economic feasibility according to:
  a. Payback period
  b. Present value of savings
  c. Annualized savings
  d. Internal rate of return

In the analysis that follows, we first consider energy aspect 1. We then examine power aspect 2, relating to the power savings of energy efficient motors.

In commercial and industrial installations, the monthly cost of electricity depends upon the peak demand (kW) and the energy consumed (kW·h). The energy portion of the cost varies according to a sliding scale, with first and second, energy blocks having rates such as 7.8 ¢/kW·h and 5.6 ¢/kW·h, and ending with a "balance" block rate, say, of 3 ¢/kW·h.

Each energy block comprises a certain number of kilowatthours. Thus, the first block might comprise 20 000 kW·h, the second block 280 000 kW·h, while the balance block would accommodate all energy in excess of 300 000 kW·h. As the plant consumes energy in the course of one month, it uses up the first block, then encroaches on the second block and may eventually reach the balance block, provided the consumption is large enough.

The energy block that is *ultimately* reached (1st, 2nd, or balance block) depends therefore upon the consumption. In our example, if a client consumes less than 20 000 kW·h the "ultimate" block is simply block 1. But if a plant consumes 45 000 kW·h during the month, the ultimate block corresponds to block 2. In effect, the first block has been used up, we have reached block 2 but consumption has not been sufficient to reach the balance block. The energy component of the electricity bill amounts to

$$20\,000 \times 0.078 + (45\,000 - 20\,000\,) \times 0.056 = 2960\ \$.$$

On the other hand, for a client that consumes 450 000 kW·h, the ultimate block corresponds to the balance block. The energy bill amounts to 20 000 $\times$ 0.078 + 280 000 $\times$ 0.056 + (450 000 – 300 000) $\times$ 0.03 = 21 740 $.

The rate of the ultimate block is particularly important because it is used in evaluating the energy savings of energy efficient motors.

TABLE 2
MOTOR SPECIFICATIONS

	standard induction motor	energy efficient motor
1) mechanical power output	100 hp (= 74.6 kW)	100 hp (= 74.6 kW)
2) full-load efficiency	91.7%	95.9%
3) full-load speed	1780 r/min	1790 r/min
4) noise level	86 dB	80 dB
5) list price	7600 $	9000 $
6) customer discount	25%	25%
7) user cost	5700$	6750$
other data and calculations		
8) electric power input (1)/(2)	81.35 kW	77.79 kW
9) operation (hours per year)	5000	5000
10) kW·h consume per year (8) x (9)	406 750	388 950
11) difference in energy consumed	17 800 kW·h	
12) rate of ultimate energy block (year 1)	4.6 ¢/kW·h	
13) dollar savings (year 1) (11) x (12)	819 $	
14) expected service life	6 years	6 years

We begin our analysis by assuming that the motor under study does not run when the peak demand occurs, and so it does not contribute to the peak demand of the plant. We also assume that the plant energy consumption is such that it reaches an ultimate energy block (either the 1st, 2nd, or balance block) whose rate, in ¢/kW.h, is known. This ultimate block can be deduced from a knowledge of the utility rate structure, the peak demand and the total energy consumed by the plant during the month.

With these assumptions, and by using the known rate of the "ultimate" energy block, we obtain an estimate of the *minimum* savings that can be realized when a standard motor is replaced by an energy efficient motor. If the motor is running at full load when the peak demand occurs, the so-called coincidence factor is unity, and savings are even greater. These power savings are considered later.

As mentioned above, there are several ways of expressing the savings offered by energy efficient motors:
  a. savings based on payback period
  b. capitalized value of savings
  c. annualized value of savings
  d. internal rate of return

These methods provide four different views of the realized savings.

The following examples show how these savings indicators are arrived at. Towards this end, we compare two 3-phase, 100 hp, 1800 r/min, 575 V, 60 Hz totally-enclosed fan cooled (TEFC) induction motors operating at full load, 5000 hours per year. The motor specifications are listed in Table 2. The efficiency of the energy efficient motor is particularly high because it is in the "premium efficiency" class. The motors are assumed to have a service life of 6 years, representing the time before a major overhaul or repair is required.

In this example, we assume that the price of the ultimate energy block is 4.6 ¢/kWh for the first year and that it increases by 7% per year. The inflation rate is assumed to be 5%.

The energy rate of 4.6 ¢/kWh is realistic for a Canadian consumer having a demand between 100 kW and 5000 kW. However, the actual ultimate block rate could typically lie between 3 ¢/kWh and 8 ¢/kWh, depending upon the particular utility rate structure, the plant load factor, and the peak demand. Load factor is defined as the ratio of energy consumed, to the energy that would be consumed if the plant operated at its peak demand, 720 hours per month.

TABLE 3
PRESENT VALUE OF SAVINGS OF THE ENERGY EFFICIENT MOTOR

Item	year 1	year 2	year 3	year 4	year 5	year 6
energy cost (per unit)	1	1.02	1.02^2	1.02^3	1.02^4	1.02^5
energy saved end of year ($)	819	835	852	869	886	904
real interest rate	4 %	4 %	4 %	4 %	4 %	4 %
discount factor	1/1.04	$1/1.04^2$	$1/1.04^3$	$1/1.04^4$	$1/1.04^5$	$1/1.04^6$
present value of energy saved	787	772	757	743	728	714

sum of present values of savings = 787 + 772 + 757 + 743 + 728 + 714 = **4501 $**

cost of motor = **6750 $**

Payback period

The payback period is the time required for an energy efficient motor to pay for itself, as compared to the price of a standard motor.

Referring to Table 2, we observe that the energy efficient motor consumes 17 800 kWh less energy per year than does the standard motor. Consequently, the energy efficient motor generates savings of **819 $** during year 1.

The premium of the energy efficient motor is equal to the cost of energy efficient motor – cost of standard motor:

6750$ – 5700$ = **1050 $**

As a result, the payback period is

$$\text{payback period} = \frac{\text{premium of energy efficient motor}}{\text{annual saving during year 1}} = \frac{1050\ \$}{819\ \$} = 1.28\ \textbf{years}$$

The energy efficient motor pays for itself in slightly more than a year. However, this is only part of the story because subsequent to the payback period, the energy efficient motor saves at least 819 $ per year for its remaining service life. Furthermore, if a utility incentive program is available, the payback period is even shorter and the corresponding savings greater.

Present value of savings

To calculate the present value of savings, we have to capitalize the savings, taking into account the 6-year service life of the motor.

We also factor in the expected annual increase (¢/kWh) in the ultimate block rate and the expected rate of inflation. We want to express all results in constant dollars, i.e. in terms of the purchasing power of money in year 1. Consequently, the real annual increase in energy cost is approximately equal to the difference between the expected increase in energy costs and the expected rate of inflation .

Real annual increase of energy cost $E = 7\% - 5\% = \mathbf{2\%}$. (1)

Thus, the cost of energy increases by a factor of 1.02 from year to year. The result is shown in Table 3.

To determine the present value of the savings, we assume a nominal interest rate of 9% which represents the *apparent* cost of money. However, the real interest rate is approximately equal to the nominal rate minus the rate of inflation.

Real interest rate $R = 9\% - 5\% = 4\% = \mathbf{0.04}$. (2)
The annual discount factor $= 1/(1+R) = \mathbf{1/1.04}$

The factors E and R enable us to complete Table 3 for the energy efficient motor. For example, the 886 $ saved in year 5 is equivalent to saving 728 $ in year 1, and investing this amount for 5 years at 4% compounded annually.

The present value of all savings over the 6-year period amounts to 4501 $.

If these capitalized savings are attributed to the cost of the motor, the real cost of the energy efficient motor is:

6750 – 4501 = 2249 $

About the author

R.I. (CY) SAVARD was graduated in 1955 from the General Electric Test Course, Peterborough, Ontario. He retired in 1990 after 35 years of service with GE Canada, where he filled various positions in the marketing of industrial type products, mainly AC motors and controls. Upon retirement, Cy Savard accepted a position with Hydro Québec as technical advisor in the development of Hydro-Québec's High Efficiency Motor program, launched in April 1991.

In this picture, Cy explains the distinguishing features of a standard and an energy efficient motor to a group of industrialists.

(1) *The exact value of $E = (1.07/1.05) - 1 = 0.019 = 1.9$ %.*
(2) *The exact vaue of $R = (1.09/1.05) - 1 = 0.038$.*
* *Typical grant for this type of motor under current incentive plans.*

In addition, if the incentive program of the utility company provides a grant, say, of 1514 $*, the real cost of the motor drops to 2249 – 1514 = **735 $**, a truly bargain-basement price !

The capitalized savings of the energy can be calculated more quickly by applying the formula:

$$\text{capitalized savings} = \text{savings (year 1)} \times \frac{1 - \left(\frac{1+E}{1+R}\right)^N}{R - E}$$

where N is the service life of the motor. For example, the capitalized savings of the energy efficient motor amount to:

$$\text{capitalized savings} = \text{savings (year 1)} \times \frac{1 - \left(\frac{1+0.02}{1+0.04}\right)^6}{0.04 - 0.02}$$

$$= 819 \times \frac{1 - 0.890}{0.02} = 4501 \text{ \$}$$

Annualized savings

Table 3 shows that the present value of savings is equal to 4501 $. It is useful to calculate the *uniform* yearly savings S that will generate this present value over a period of 6 years, using the real interest rate of 4%. This value can be calculated by solving the equation:

$$4501 = \frac{S}{1.04} + \frac{S}{1.04^2} + \frac{S}{1.04^3} + \frac{S}{1.04^4} + \frac{S}{1.04^5} + \frac{S}{1.04^6}$$

This geometric progression yields the result S = **858 $**. It can be found from the equation:

$$S = \frac{\text{Present value} \times R}{1 - (1+R)^{-N}}$$

Thus, for the energy efficient motor whose present value of savings is 4501 $, we obtain the following annualized inflation-free savings:

$$S = \frac{4501 \times 0.04}{1 - (1 + 0.04)^{-6}} = 858 \text{ \$}$$

If we take the 1514 $ grant into account, the present value of the savings becomes 4501 + 1514 = 6015 $ which raises the annualized savings to **1147 $.**

Internal rate of return

We have seen that the purchase of the energy efficient motor requires an additional investment of 1050 $ over the price of a standard motor. On the other hand, Table 3 reveals that this investment produces annual savings ranging from 819 $ in year 1 to 904 $ in year 6. The question is, what do these savings represent in terms of return on investment? This so-called *internal rate of return I* equates the 1050 $ investment to the present value of the savings. The rate is found from the expression:

$$1050 = \frac{819}{(1+I)} + \frac{835}{(1+I)^2} + \frac{852}{(1+I)^3} + \frac{869}{(1+I)^4} + \frac{886}{(1+I)^5} + \frac{904}{(1+I)^6}$$

The solution can only be obtained by successive approximation. It yields the result $I = 0.77$, which corresponds to an inflation-free annual return on investment of 77 percent. This very attractive return may well be the deciding factor when it comes to replacing a standard motor by an energy efficient motor.

Savings due to reduced peak demand

So far we have assumed the motor is not running when the peak demand of the plant occurs. This corresponds to a coincidence factor of zero. It is a very conservative assumption, because in many cases, the motor will be running at full load when the plant operates at peak production. This corresponds to a coincidence factor of unity. Under these circumstances, the reduced power consumption of the energy efficient motor permits additional savings. In our example (Table 2), the energy efficient motor consumes 77.79 kW, while the standard motor draws 81.35 kW. If this premium efficiency motor is used in place of the standard motor, the drop in peak demand of the plant is 81.35 – 77.79 = 3.56 kW.

The rate structure of utilities is such that the monthly bill includes a peak demand charge ranging typically from 6 $ to 9 $ per kilowatt, depending on the utility. Assuming a demand charge of 6 $/kW, the drop in demand of 3.56 kW represents a monthly saving of 6 × 3.56 = 21.36 $, or about 256 $ per year. As a result, the saving for year 1 in Table 3 becomes 819 + 256 = 1075 $ instead of 819 $. If the annual percentage price increase in the demand charge is the same as that for energy (7%), we find:

(1) The payback period drops to 1050/1075 = 0.98 years.

(2) The sum of the present values of savings rises to:
4501 × (1075/819) = 5908 $.

(3) The real cost of the energy efficient motor is :
6750 – 5908 = 842 $

Table 4 lists the new savings and compares them with those in Table 3. Depending on the coincidence factor (between 0 and 1), the payback period, return on investment, and so forth, will lie somewhere between these minimum and maximum values.

TABLE 4
COMPARISON OF MIN AND MAX SAVINGS

	coincidence factor = 0	**coincidence factor = 1**
savings at end of year 1	819 $	1075 $
(a) payback period	1.28 years	0.98 years
(b) present value of savings	4501 $	5908 $
(c) annualized savings	858 $	1126 $
(d) internal rate of return	77 %	102 %
cost of energy efficient motor	6750 $	6750 $
real cost of motor	2249 $	842 $

Rewinding motors

When a standard motor fails, the decision has to be made whether to rewind it or replace it with a standard or an energy efficient motor. The decision will be influenced by additional factors, such as the relative cost of rewinding, and the expected efficiency value after the rewind. In the 1 kW to 20 kW range, it is usually cheaper to buy a new motor.

Rewinding an electric motor that has failed may result in additional losses and consequent lower efficiency, depending on the methods used in the stripping process and winding replacement. A poorly rewound motor can result in both higher operating costs due to greater energy consumption and a shorter life expectancy due to higher operating temperature.

Energy efficient motors are expected to have a longer life than standard motors operating under the same conditions. Furthermore, they are much quieter. For example, the 6 dB difference in sound level indicated in Table 2 means that the noise produced by this standard motor is equivalent to that of *four* energy efficient motors.

Conclusion

Energy efficient motors generate savings by reducing the energy costs associated with their operation. Furthermore, additional savings are possible because energy efficient motors invariably reduce the peak demand of the plant. Therefore it makes sense to select a motor with the highest efficiency. Buying motors on price only could be a costly error. Operating costs and potential savings should be given full consideration when replacing failed or in-service motors, or when specifying motors for a new project.

In making the feasibility study, any one of the four methods mentioned above can be used to arrive at a rational decision. They are equivalent statements of the savings that are realized. ■

Letters to the editor/ Lettres à l'éditeur

In response to "GE Canada - 100 years in Peterborough" (IEEE Canadian Review - 1991 Fall), it grieves me to see, after 100 years, that GE Canada still does not express power in kilowatts. This is a "world-class facility" providing information to a modern publication of the technical community.

It should be worth noting that the input to motors is measured in watts (whoever saw a horsepower meter on a switchboard?). Logically, then, for an efficiency (say) of 90 %, the efficiency of motors ought to be expressed as 1.206 hp/kW (not unlike the Btu/hr/kW of the power plant engineers)!

The question continues - why do we, engineers, continue to fumble around with mixed units? Can we not extricate ourselves from this quagmire? Perhaps the place to start would be in standards setting areas such as EEMAC, where hp would be phased out in favor of kW for the standard ratings of electric motors.

It seems to me that until we, in the electrical sector, adopt kW, it would be unreasonable to expect the automotive sector to get the horse out of the horseless carriage. We are both in the technical community and should be able to manage this business of standardizing the units we use, especially when that wheel (SI) has already been invented.

D.T.Bath
Peterborough, Ontario

Editor's note:

The horsepower unit raises a particularly difficult issue because the ratio between it and the watt is not a simple number. In effect, using the relationship 1 hp = 550 ft·lbf/s and the modern definitions of SI units, we discover that, to 8-figure accuracy, 1 hp is equal to 745.699 87 watts. This is nearly equal to 0.746 kW, the value usually assigned to one horsepower.

The problem is compounded because North American standards concerning electric motors have historically used multiples of the horsepower to express mechanical power.

If James Watt's dray horses had been more productive and been deemed to produce an average output of 738 ft·lbf/s (instead of 550 ft·lbf/s), we would long ago have changed over to SI units because it would have yielded the nice "power" series: 2 kW, 3 kW, 5 kW, etc. corresponding to the standardized ratings of 2 hp, 3 hp, 5 hp, etc. motors.

As Mr. Bath points out, it would be informative to know what the pertinent EEMAC committees are doing about this situation and if a plan is under way to resolve it. Can someone shed more light on this matter?

Letters to the editor

Letters should be addressed to the Managing Editor. They should include the writer's name, address and telephone number and may be edited for purposes of clarity or space.

Assistance

Should any member of IEEE Canada experience problems related to membership, periodicals, activities, etc., please contact the IEEE Canada Office by mail, telephone, fax or email, at any time. We will be pleased to help you.

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Thank you Tony and Gerry !

Tony and **Gerry Eastham** have been serving as the Managing Editors for the IEEE Canadian Review for the past three issues. The duties of being the IEEE Canada Director are challenging enough for both spouses, but Tony and Gerry have served our Review in a special way by stepping in to fill the breach between editorships. On behalf of myself and all members of the IEEE family, thank you, Tony and Gerry, for doing both jobs splendidly.

Bob Alden, Chairman of the Advisory Board, IEEE Canadian Review.

Announcing IEEE CANADA DAY

Saturday, February 1, 1992 has been designated as **IEEE Canada Day**. In particular, the live satellite coverage of the 18th Great Northern Concrete Toboggan Race in Montreal will be broadcast across the country to universities and colleges.

Under the guidance of **Jean-Denis Hurtubise** and the IEEE Student Branch of l'École de Technologie Supérieure, this broadcast not only represents a first for IEEE Canada students, but also marks the 125th anniversary of Canada. CANADA 125 has been alerted of this event for approval under their guidelines. CANADA 125 is looking for other activities throughout 1992 designated as birthday events; if you need more information, please call IEEE Canada Office.

Special announcement

Bob Alden, former IEEE Canada Director and IEEE Vice President, has announced that he will seek the IEEE presidency as a petition candidate.

Blicq in Moscow

Ron Blicq has now returned from his trip to Moscow. The Colloquium and associated activities were a great success. Ten Professional Communications Society (PCS) representatives from Canada, the United States and England attended and did their utmost to further international communication.

During his visit, Ron met with **Dr. Vladislav M. Pavlov**, Chief of the International Centre for Scientific & Technical Information Protocol Department. They discussed the feasibility of holding a series of Russian-language courses for IEEE members in Moscow and other cities.

Obituary

Sadly we announce the sudden death of **W. Harry Prevey** on November 27, 1991, in his 81st year. Harry joined IEEE in 1947, became a Senior Member in 1954 and a Life Senior in 1980. A member of the Industrial Applications Society, he was a very active Member-at-Large of the Toronto Section. In recent years Harry will be remembered as the Editor of the Region 7 Centennial Publication "Electricity, The Magic Medium" - a mammoth task. Harry will be missed by many.

IEEE Canada Student Papers Presentation

From left to right standing: **Phil Scoones**, SAC Vice Chairman CCC, **Brad Woodfine, Philip Zuk, Raymond Chase, Brian deWalle,** Pam Woodrow, **Roger Cordeau, Andrew Small, Ed Spike,** Region 7 SAC Chairman;
Sitting: **Sandy Artinger,** Standard Sales, *Inset:* **Xin Huang**.
The photograph was taken at the IEEE Booth.

Seven students presented their winning papers at the High Technology Show on Thursday, October 31, 1991 in Toronto. The winning papers were:

Life Member Award, Western Canada Council (WCC)

Philip Zuk, of Red River Community College and **Brad Woodfine** , from Winnipeg, for "The Design, Building and Testing of a Z80 Controlled, Dual Speed Floor Tracking Robot".

Hackbusch Award (WCC)

Andrew Small of the University of Manitoba, Winnipeg, for "A Neural Network Flight Control System using Back Programming".

Palin Award (WCC)

Raymond Chase of Southern Alberta Institute of Technology, Calgary, for "Hard Disk System".

Life Member Award Central Canada Council (CCC)

John Toulmin of Niagara College, Welland, for "Flight Simulation Software".

Palin Award (CCC)

Brian deWalle of Ryerson Polytechnical Institute, Toronto, for "Programmable Waveform Synthesizer for the IBM PC".

Life Member Award Eastern Canada Council (ECC)

Xin Huang of the University of Ottawa, Ottawa, for "Numerical Performance Analysis of Optical Tapers used in Free Space/Atmospheric Optical Links".

Hackbusch Award (ECC)

Roger Cordeau of Carleton University, Ottawa, for "Environmentally Isolated Robot".

Beam Robotics and Micromouse Competition 1991

The **Beam Robotics and Micromouse Competition**, held from October 31 to November 3, at Humber College in Toronto, was a success, with live coverage extending as far away as Australia and the United Kingdom. Not only that, but TV Ontario's show "FROG" (Friends, Researchers and Other Gismos) which will be broadcast in September 1992, will select portions from some video tapings presently underway in the newly opened McNaughton Learning Resource Centre at the University of Waterloo.

The Committee who worked on the 1991 Competition are busy trying to collect newspaper clippings from around the world, so that a media-impact package can be assembled for future events. When interviewed, **Mark Tilden** of the University of Waterloo and chairman of the event said "I never would have thought fame would take so much time". Certainly, local media coverage was excellent.

Thanks are extended to all organizers who helped with the show and to Humber College, IEEE Canada, Motorola Canada, Spar Aerospace and the University of Waterloo for their help.

Among the many prizes that were awarded, we list the following:

Special Technical Award

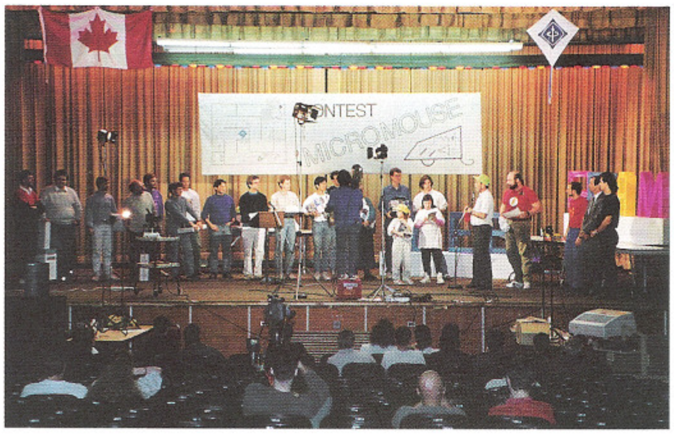
Giraffe 1.0 - Simon Fraser University. Their handcrafted Micromouse robot used a Fisher-Price Handycam mounted on a raised boom. It was called the SFU Giraffe but looked more like a metal Loch Ness Monster.

Youngest Entrants

Melissa Spike (7) and Allison Spike (10).

Special Award

Fred Martin, Anne Wright, Darrin Jewell, Randy Sargent, P.K.Oberoi, Ryan Smith, Mike Plusch, Shaun Kaneshiro, Karsten Ulland, Matt Domsch and **Mike Gull** for spending megahours coming up with their hilarious Robot Ballet Sequence.



The 1st Annual BEAM Robotics & Micromouse Competition finished in a flourish of media publicity and exhausted competitors. More than 30 competitors showed up with over 40 creations to pit their technology against each other and the perversity of animate objects.