REGULATORY SUMMARY FOR

PREMIUM EFFICIENCY ELECTRIC MOTORS

Comment - The title infers that the only purpose of the Regulatory Summary is with regards to Premium Efficiency Electric Motors. In the body of the Summary the only type of motors for which Premium Efficiency levels are being established are those of the "general purpose electric motor (subtype I)" classification. The efficiency levels for all other motor types covered in the Summary are classified as "Energy Efficient". The title should be changed to reflect the full intent of the Summary.

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Proposed Regulatory Area: 1-500 hp electric motors

Type of Device	(A) GENERAL PURPOSE ELECTRIC MOTOR (SUBTYPE I). The term 'general purpose electric motor (subtype I)' means any motor that meets the definition of 'General Purpose' where *General purpose motor* means any motor which is designed in standard ratings with either: (i) Standard operating characteristics and standard mechanical construction for use under usual service conditions, such as those specified NEMA Standards Publication MG1[1], "Usual Service Conditions," and without restriction to a particular application or type of application; or (ii) Standard operating characteristics or standard mechanical construction for use under unusual service conditions, such as those specified in NEMA Standards Publication MG-1, "Unusual Service Conditions," or for a particular type of application, and which can be used in most general purpose applications.
Comment	The above definition for "general purpose electric motor (subtype I)" covers all general purpose motors regardless of frame size, NEMA Design type, application, foot-mounted and footless, vertical or horizontal, number of poles, and voltage, including voltages above 600 volts. With this definition there is no need for the definition in (B) for subtype II. In the section "**Regulatory Requirements Avoid or Eliminate Duplication with Other Jurisdictions**" it is stated that the intent is to "raise the minimum efficiency level for 1-200 hp motors that are currently covered by EPAct 1992 to NEMA Premium levels (NEMA MG Table 12-12), except for fire pump motors which remain at EPAct levels". While the U.S. Department of Energy is working on clarifying the above definition, it is recommended that the definition of a "general purpose electric motor (subtype I)" herein be based on the definition of "motor" in Section 2.(1) of the present NRCan Energy Efficiency Regulations, SOR94/651 which identifies those motors presently covered by the 1992 efficiency regulations. That definition is copied here: "motor" means a product described in paragraph (*a*) or (*b*) and includes any such product that is incorporated into any other product, whether or not the other product is an energy-using product: (*a*) a continuous duty operation, open or enclosed, electric induction

[1] National Electrical Manufacturers Association (NEMA) Standards Publication MG1–2006 (MG1), *Motors and Generators*

	motor of the polyphase, squirrel cage, NEMA design A- or B-type, that is designed to operate at a single speed and that has (i) two, four or six poles, (ii) a rated voltage of not more than 600 volts, (iii) a rated frequency of 50/60 Hz or 60 Hz, (iv) a rated power of not less than one HP and not more than 200 HP, (v) a T frame, (vi) a standard shaft, an R-shaft or an S-shaft, (vii) a foot mounting, a type C face-mounting or a type D flange-mounting, and (viii) an IP code from 00 to 66, or *b*) a maximum continuous rating, open or enclosed, electric motor of the three-phase, cage, IEC design N-type and S1 duty-type, that is designed to operate at a single speed, that is either flange-mounted or foot-mounted, and that has (i) two, four or six poles, (ii) a rated voltage of not more than 600 volts, (iii) a rated frequency of 50/60 Hz or 60 Hz, (iv) a rated power of not less than 0.746 kW and not more than 150 kW, (v) a frame number of 90 or above, and (vi) an IP code from 00 to 66; (*moteur*) By adopting the present definition of "motor" for "general purpose electric motor (subtype I)" then it should be clear that the definition of "general purpose electric motor (subtype II)" in (B) would then be pertinent. This is consistent with the intent in the Proposed Energy Performance Standard section to increase the level of efficiency of presently covered "motors" to the higher efficiency levels in NEMA MG1 Table 12-12 while establishing efficiency requirements for motors of subtype II at the levels in NEMA MG1 Table 12-11. (B) GENERAL PURPOSE ELECTRIC MOTOR (SUBTYPE II). The term ‘general purpose electric motor (subtype II)’ means motors incorporating the design elements of a general purpose electric motor (subtype I) that are configured as 1 of the following: (i) A U-Frame Motor. (ii) A Design C Motor. (iii) A close-coupled pump motor. (iv) A Footless motor. (v) A vertical solid shaft normal thrust motor (as tested in a horizontal configuration).

	(vi) An 8-pole motor (900 rpm). (vii) A poly-phase motor with voltage of not more than 600 volts (other than 230 or 460 volts).
Comment	In the definition "1" should be "any" as the use of "1" can create confusion as to whether or not a subtype II motor can have only "1" variation from a subtype I. A footless Design C motor is common, but would appear to be exempt from the subtype II classification because it differs from a subtype I motor in 2 areas. As noted previously this definition is not pertinent if the original definition for subtype I is adopted in lieu of the present definition in NRCan Regulations. Consideration should be given to including "hydraulic pump motors" in addition to "close-coupled pump motors".
	(C) NEMA Design B general purpose motors from 201-500 hp as defined in NEMA MG1
Comment	IEC Design N motors rated 151-375 kW should be included.
	(D) Fire pump motors as defined in NEMA MG1
Comment	Fire pump motors are not defined in any NEMA Standard. The requirements for fire pump motors in the U.S. are contained in NFPA 20. In actual application, these motors are intermittent duty and only used for emergency purpose. They should not be included in the proposal.
Test Standard	CSA Standard C390, *Energy Efficiency Test Methods for Three Phase Induction Motors*
Comment	The equivalent IEEE 112 and IEC 60034-2-1 test methods should be included. Note: A revised edition of C390 is expected to be issued in 2009 which will contain the NEMA Premium Efficiency tables.

Current BC Regulation **Comment**	Electric induction motors, other than integral gear motors, that are polyphase, squirrel cage, single speed, NEMA/EEMAC Design A or B from 1 to 200 horsepower CSA Standard C390-93, *Energy Efficiency Test Methods for Three Phase Induction Motors* – Table 3 Table 3 is a table of Nominal Efficiency Tolerances. The correct table is Table 2 of Minimum Nominal Efficiency. If this correction is made then it is not clear as to what the intended difference is between the above statement of covered motors and the similar statement below. It should be noted that the present version of CSA C390 is 1998 where Table 2 is for motors rated in Hp and there is a Table 2A for motors rated in kW. Electric induction motors, other than integral gear motors, that are polyphase, squirrel cage, single speed, NEMA/EEMAC Design A or B from 1 to 200 horsepower, including electric induction motors incorporated into other equipment, unless that equipment has a prescribed standard under section 7 of the Energy Efficiency Standards Regulation. CSA Standard C390-93, *Energy Efficiency Test Methods for Three Phase Induction Motors* – Table 2
Proposed Energy Performance Standard **Comment**	(A) GENERAL PURPOSE ELECTRIC MOTORS (SUBTYPE I). Except as provided in subparagraph (B), each general purpose electric motor (subtype I) with a power rating of 1 horsepower or greater, but not greater than 200 horsepower, manufactured (alone or as a component of another piece of equipment) shall have a nominal full load efficiency that is not less than as defined in MG1 Table 12-12. It appears that the text of this section is from the U.S. Energy Independence and Security Act of 2007. In that Act subparagraph (B) referred to in subparagraph (A) above was with regards to fire pump motors and subparagraph (C) was with regards to general purpose electric motors (subtype II). Either the reference to "(B)" above should be changed to "(C)" or the actual subparagraphs (B) and (C) below be interchanged. The intent of the exception in subparagraph (A) is to recognise that while a fire pump motor is a general purpose electric motor (subtype I) it is not intended to require the efficiency level of the motors to be increased to premium efficiency levels. This is also stated in the section "**Regulatory Requirements Avoid or Eliminate Duplication with Other Jurisdictions.**"

Comment	The efficiency levels should also apply to motors rated in kW up to 150 kW. (B) GENERAL PURPOSE ELECTRIC MOTORS (SUBTYPE II). Each general purpose electric motor (subtype II) with a power rating of 1 horsepower or greater, but not greater than 200 horsepower, manufactured (alone or as a component of another piece of equipment) shall have a nominal full load efficiency that is not less than as defined in MG1 Table 12-11. The efficiency levels should also apply to motors rated in kW up to 150 kW. (C) FIRE PUMP MOTORS. Each fire pump motor manufactured (alone or as a component of another piece of equipment) shall have nominal full load efficiency that is not less than as defined in MG1 Table 12-11. (D) NEMA DESIGN B, GENERAL PURPOSE ELECTRIC MOTORS. Each NEMA Design B, general purpose electric motor with a power rating of more than 200 horsepower, but not greater than 500 horsepower, manufactured (alone or as a component of another piece of equipment) shall have a nominal full load efficiency that is not less than as defined in MG1 Table 12-11.
Comment	IEC Design N motors rated 150 kW through 375 kW should be included.
Effective Date	January 1, 2011
Certification	No change to the current scheme for product compliance verification is anticipated.
Need for the Regulation	New regulation supports the policies and targets of *The BC Energy Plan: A Vision for Clean Energy Leadership*, and positions BC as a leading jurisdiction in North America on energy efficiency standards for electric motors. By harmonizing with planned regulation in the United States, and potentially across all of Canada, BC will ensure that the highest levels of efficiency practical will be achieved for electric motors within the scope of this regulation.

Results Based Regulatory Design	Regulation is based on energy performance, resulting in tangible electricity savings for all consumers.
Transparent Regulation Development (Acceptability)	Development of regulation involved the following procedure: • Identified a potential standard • Identified test procedure • Market analysis • Economic assessment • Regulatory assessment • Industry consultation workshop – targeted outreach to Manufacturers/Distributors (September 15, 2008) • Formal stakeholder consultation, with written responses to regulatory impact statement (Dec 1, 2008-Dec 31, 2009)

Market Trans-formation Strategy	**BC Hydro Power Smart Programs** • Efficient Motor Program BC Hydro Power Smart conducted a market transformation program for large industrial motors from 1992 to 1994. The program was able to shift the market to EPACT 1992 motors within 2 years with a combination of incentives and standards adoption. • Motor Management Planning Since December, 2006, the Power Smart office, in coordination with BC motor repair shops who are members of EASA Western Canada, has provided technical assistance to help transmission customers reduce the costs of motor ownership by helping them make sound motor decisions. The program analyzes the customer's current motor management practices and then works closely with customers to customize a motor management plan for them by upgrading practices that do not reflect best practice in motor management. **FortisBC PowerSense Programs** (serving the Okanagan and West Kootenay regions) In addition to offering free walk-through energy audits conducted by qualified technical advisors, FortisBC PowerSense offers industrial facilities expert advice as well as rebates on energy-efficient technologies and solutions. The rebate entitlement is based on 5¢ per estimated annual kWh savings, with the maximum rebate calculated to achieve a two-year payback on incremental cost. **Provincial Government – Fiscal Measures** The provincial government provides a Provincial Sales Tax exemption for products purchased for production machinery and equipment, including industrial motors. Manufacturers may qualify for a PST exemption when they purchase or lease certain production machinery and equipment (PM&E). The exemption includes replacement parts and services for qualifying PM&E, parts to assemble qualifying PM&E, and certain manufacturing services. Qualifying manufacturing activities must also meet minimum levels of sales or manufactured costs. The machinery and equipment must also be used primarily and directly in manufacturing, and used at an eligible manufacturing site.

Market Trans-formation Strategy (cont.)	**Conclusion** Based on BC Hydro market research, as of 2007, NEMA Premium Efficiency (PE) motors make up approximately 60% of the annual shipments of 1-500 hp industrial non-OEM motors into the province. For the higher horsepower motors in the range, the fraction of premium efficiency motors exceeds 75%. This indicates that the BC market is already nearly transformed.

Assessment from a Consumer Perspective

Criteria	Evaluation
Capital / purchase costs	The following table reflects representative capital cost premiums currently associated with NEMA Premium Efficiency motors:

Motor Size [HP]	5	20	50	100	200
Capital Cost of EPACT Motor [$]	386	986	2,128	4,864	9,573
Capital Cost of NEMA Premium Motor [$]	453	1,176	2,913	5,643	10,322
Incremental Capital Cost [$]	67	190	785	779	749

Cost-Benefit Analysis **Energy savings for each consumer** (Affordability)	For industrial applications, the estimated energy saving from the use of a Premium Efficiency motor, compared to an EPAct motor, ranges from 375 kWh/year for a 5 hp motor to 7,640 kWh/year for a 200 hp motor. In commercial applications, where motor run times are estimated to be, on average, approximately 42% of industrial duty cycles, the savings are proportional. Net Present Value (NPV) analyses were performed for various sizes of motors within the range that this regulation proposes to capture and sensitivities were reviewed for discount rate and electricity prices (see summary table below). A positive NPV was recorded for all industrial application scenarios, with simple payback periods usually less than one year. 80% of the commercial application scenarios also resulted in a positive NPV with simple payback periods generally being two years or less. For commercial applications, the 50 hp and 100 hp premium efficiency motors showed a negative NPV in some of the higher discount rate scenarios.

Industrial

Motor Size	Net Present Value	Simple Payback (yrs)
5 hp	$ 124	0.5
20 hp	$ 517	0.4
50 hp	$ 491	1.6
100 hp	$ 714	1.1
200 hp	$3,179	0.2

Commercial

	Net Present Value	Simple Payback (yrs)
5 hp	$ 42	1.6
20 hp	$ 213	0.9
50 hp	$ -57	-13.7
100 hp	$ 72	10.8
200 hp	$1,490	0.5

* Above results from analyses using 8% discount rate

Consumer choice / quality of service (Availability)	General purpose NEMA Premium Efficiency motors have been available in the market for a number of years. The table below shows the approximate percentages that NEMA Premium Efficiency motors make up of annual sales in BC, for non-OEM motors. 2007 NEMA PE and Non – NEMA PE non-OEM motor sales estimations

	BC Estimate (percent)
	1-5 hp
	6-20 hp
	21-50 hp
	51-100 hp
	101-200 hp
	201-500 hp
	Total
NEMA Premium	
	54%
	63%
	73%
	78%
	82%
	92%
	61%
Non NEMA Premium	
	46%
	37%
	27%
	22%
	18%
	8%
	39%

Input from industry regarding International Electro-technical Commission (IEC) design N type and SI-duty type motors indicated that beta designs for non-compliant models of these motors are currently in test and are expected to be in production approximately 6 months prior to the implementation date for this regulation.

Assessment from an Industry Perspective

Range of products affected	1-500 horsepower general purpose electric induction motors. For BC manufacturers which incorporate electric motors, of the type affected by this proposed regulation, into products intended for sale within BC, Canada or the U.S. their products will be indirectly affected but on an equal footing with competitive products.
Cost impacts	Compliant products are already being sold in the BC market. Currently there is a cost premium associated with NEMA PE motors. When the regulation takes effect, harmonization across North America may lead competitive forces to drive down that premium.
Competitive Analysis	There are no motor manufacturers in BC but there several major motor distributors as well as equipment manufacturers which integrate motors into their products. BC has established a leading position in the adoption of NEMA PE motors, especially for the higher horsepower motors and for industrial applications. By harmonizing with the US in both scope and effective date any potential market imbalances from non-compliant products will be effectively eliminated.

Assessment from a Provincial Government Perspective

Economic assessment from a provincial perspective (Aggregate energy, emission and net cost savings)	Yearly electricity savings from regulation: 2.84 GWh/year. (equivalent to the total annual electricity consumption of approximately 270 households) Yearly greenhouse gas emissions savings (before electricity becomes carbon neutral): 92 tonnes. Yearly financial savings: $279,000 Net present value: $1.9 million

Regulatory Requirements Avoid or Eliminate Duplication with Other Jurisdictions	On December 19, 2007, President Bush signed the Energy Independence and Security Act of 2007, into law (Public Law 110-140). Section 313 includes new electric efficiency standards for motors. The law affects electric motor efficiency in three basic areas: It will raise the minimum efficiency level for 1-200 hp motors that are currently covered by EPAct 1992 to NEMA Premium levels (NEMA MG Table 12-12), except for fire pump motors which remain at EPAct levels. It will set new federal minimum standards for motors that were not covered by standards previously. The following motors in the 1-200 hp range must meet NEMA Energy Efficient levels (i.e. EPAct 1992, NEMA MG Table 12-11), including: • U-Frame motors • Design C motors • Close-coupled pump motors • Footless motors • Vertical solid shaft normal thrust motors (tested in a horizontal configuration) • An 8-pole motor (900 rpm) • Poly-phase motors of not more than 600 volts (other than 230 or 460 volts). It creates new federal minimum standards for NEMA design B motors, 201 to 500 hp at NEMA Energy Efficient levels (NEMA MG Table 12-11). All of the motor types above that are manufactured or imported into the U.S. (alone or as a component of another piece of equipment) must meet the efficiency standards beginning December 19, 2010. BC's proposed regulation is intended to harmonize, in terms of both scope and timing, with the US regulation. A similar harmonization, at the Canadian federal level, is under consideration at Natural Resources Canada.

Administrative Feasibility for Compliance and Enforcement	Compliance and enforcement approach under the *Energy Efficiency Act* is based on third-party verification, labelling of products and education of manufacturers, distributors, retailers and consumers with respect to energy efficiency standards and labelling requirements. The Ministry of Energy, Mines and Petroleum Resources is developing a compliance and enforcement framework for all products and appliances covered under the *Energy Efficiency Act.* The Ministry's approach to compliance and enforcement for electric motors is based on third-party certification and labelling based on testing of nominal full load efficiency for the electric motor products covered under this regulation. The labelling indicates that products are compliant with the regulation. These third party certification organizations are recognized by the Standards Council of Canada and have their own procedures for enforcing the use of their labels. The first step toward fulfilling compliance to the regulation is to ensure broad public awareness about the new efficiency standards. Secondly, we would like to encourage commercial and industry participants to identify and report non-compliance. Finally, further enforcement measures are under development by Ministry staff. The compliance and enforcement framework is still in the developmental stages and the Ministry welcomes suggestions on how to best ensure compliance, while promoting a thriving and competitive motor sector in the province.
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Table 1. Timelines for Federal, Provincial and U.S. regulations for NEMA Premium Efficiency electric motors

Effective Date of Regulation	
US DOE	December 19, 2010
Province of BC proposed	January 1, 2011
NRCan (anticipated)	January 1, 2011