

Invitation for Proposals

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CUSTOMER ENERGY SOLUTIONS INTEREST GROUP (CESIG)

CEATI PROJECT No. CESIG-10-01

**ESTIMATING MOTOR EFFICIENCY OF AC 3 PHASE INDUCTION MOTORS
USING STANDARD NO LOAD TESTS**

CEATI International Inc. (CEATI) invites the submission of proposals to perform research work on the following topic:

TITLE

Estimating Motor Efficiency of Three Phase A.C. Motors Using Standard No-Load Tests

INTRODUCTION

A.C. induction motors that have operated for years experiencing multiple failures and repairs may operate below their original nameplate ratings or assumed efficiency. Numerous investigations of new motor efficiency were conducted, while very little work investigating the actual running efficiency of older motors in the field was reported. Studies have shown that repaired motors appear to operate below their nameplates and below the projections of many of the standard motor decision tools. While these studies concede the importance of motor loading on the effective operational efficiency of the motor, they do not utilize standard testing methods to determine this efficiency using dynamometers but rather assume nameplate values for their comparisons.

An algorithm using a series of simple motor tests (no-load power and cold resistance) which are typically conducted by motor service centres has been developed at BC Hydro and named “Simulation of Motor Efficiency based on Routine Testing” or (SMERT). The BC Hydro paper is attached to this Invitation for Proposals as Appendix 1.

CESIG members sponsoring this development assume that with hard data, the economics of motor “repair versus replace” decisions could change significantly. If true, this could appreciably boost the efficiency of the industrial motor population through increased penetration of high efficiency motors, such as the NEMA Premium™ line. At the same time, motor service centres will offer increased quality assurance for the motor repair and rewind work they are conducting by being able to estimate repaired motors efficiency by using a credible methodology not involving standard and costly dynamometer testing.

PROJECT OBJECTIVES

Develop a more accurate simple tool than the existing “SMERT 1” for calculating efficiency of repaired and rewound AC induction motors in the field, at 100%, 75%, 50% load minimum, using standard no load power and no load current and nameplate data.

Mathematical model is to comply with the requirements of motor testing standards now deployed: CSA 390; IEEE 112; EN 60034-2, EN 600 34-30; IEC 61972.

Basic measurement data that is currently collected during the motor repair or refurbishment process should be the only input data required for this software. SMERT 1 inputs are the following:

1. Cold resistance and temperature
2. No load power
3. No load current

4. Name plate details

Alternatively, the contractor may choose to develop own software to achieve the same results. Motors targeted in this project are AC three-phase squirrel-cage induction motors from 200 V and 7000 V.

SCOPE OF THE STUDY

The outcome of this project will be an enhanced software tool to more accurately assess the economic benefits of utilizing premium-efficiency industrial AC motors.

Tasks:

1. Improve the accuracy of “SMERT 1” by using more advanced mathematical modeling and effectively produce advanced software, “SMERT 2”. Validation and calibration of the model can be done with experimental test data, such as from Hydro Quebec, or any other available motor test data;
2. Design and validation testing of the new software “SMERT 2”.
3. Assess the effectiveness of “SMERT 2” and conduct sensitivity and error analysis under real industrial power supply conditions and non-laboratory type instrumentation for measurement of the required input data for “SMERT 2”.
4. “SMERT 2”: Evaluate the effects on motor efficiency of power supply variation and quality (voltage unbalance and harmonics) by varying voltage by +/- 10%, and frequency by +/- 2%.

POTENTIAL BENEFITS

- New tool to assess AC three-phase squirrel-cage induction motor efficiency for motors rated between 200 V and 7,500 V at much lower cost than dynamometer testing.
- New tool to assess efficiency of rewound motors and enable customers to more accurately evaluate whether to repair or replace a motor.
- Provides reliable efficiency data that enables improved energy-efficiency standard development for repaired motors
- Utility DSM programs to encourage early adoption of energy-efficient and premium efficiency motors and assurance that the investment in energy efficiency is sustained over the entire life of a motor
- Enable further refinement of DSM programs indirectly involving A.C. induction motors.
- Enable evaluation of the effects of the Electrical Distribution Supply Optimization (EDSO) on induction motor efficiency
- Measurement of Energy Savings
- The potential energy savings is estimated based on the avoided efficiency degradation with motor repair and accelerated adoption of new premium efficiency motors.

PROJECT STAGING (with approximate timing for various tasks)

R&D activity	– 1 month
Design and test of SMERT.2 *	– 3 months
Design and test of a set of various versions of mathematical models	– 2 months
Comparative testing of various software models	– 2 months
Analysis of results and technical report on SMERT.2	– 1 month

* Using existent data from testing facilities of squirrel cage motors, including Hydro Quebec – Laboratoires des Technologies de l’Energie - Shawinigan

Expected project duration is 9 – 12 months

DELIVERABLES

- SMERT.2 software, (SMERT.1 is MS-Excel based), or equivalent tool capable of estimating efficiency at 100%, 75%, 50% load minimum;
- User’s instructions and testing set-up and procedure;
- Description of instrumentation, accuracy and calibration requirements;
- Brief technical report with typical examples and calculations.

The successful proponent is expected to prepare a ready-to-publish report on the results of the investigation and present the results to funding consortium members. The completed report must be submitted for CEATI approval in editable, electronic format (Microsoft Word). In addition, the platform and version should be specified for any software or programs to be developed.

Progress reports will also be required on either a quarterly or milestone basis - normally these are scheduled to coincide with the completion of the identified tasks.

The successful proponent is also expected to provide the following:

- A ten to fifteen (10-15) slide Power Point Presentation. This should be composed of three main sections:
 1. The factors motivating the initiation of the work;
 2. A description of the main findings;
 3. Summary of the conclusions and recommendations for future research.
- Contents for the Project’s Technical Brief. This is a summary of the report (between 1,000 and 1,500 words), which is published separately by CEATI. Proponents are not responsible for the preparation of a ready-to-print Technical Brief, but solely to provide the contents for the following 4 sections: Background, Summary, Conclusions and Recommendations.
 1. The Report Background section should be short (approximately 200 words) and should detail the reasons the work was conducted.
 2. The Summary section should be approximately 700 words. It must provide a general description of the work program.

3. The Conclusions section should be about 150 words and should provide a general outline of the key results (do not include specifics).
4. The Recommendations section should be about 200 words and should include a description of the potential applications of the results.

Please note that all reporting must be submitted in English. If written English is not the author's strong suit, it is recommended that a technical writer be hired to review the document prior to submission.

BUDGET AND SCHEDULE

The proposal must contain a schedule and a quote of required remuneration for the work in US or Canadian dollars. All prices shall be presumed to be in Canadian dollars (CAD) unless explicitly specified otherwise in the proposal. Proponents' responses to this section must include a full breakdown of the budget and schedule, including an indication of rates and hours and the task allocation for the key personnel by task and must correspond to any phases or milestones outlined above. (Please refer to the Proposal Template for more information).

It is expected that this project can be completed (draft final report submitted for review and approval) within 9 - 12 months of initiation.

The proposal must include the names and qualifications of the key individuals who will be involved, as well as the name of the accountable manager.

CEATI is not bound to accept any proposal but any selection will take into account technical merit, qualifications, price and schedule. A proposal may be accepted in whole or in part. A commitment to proceed with the first phase of a multi-phase project does not automatically imply that the work of the subsequent phases will be undertaken.

ALTERNATIVE WORKS

Proponents shall generally follow the above description of work, but are encouraged to offer alternative works if these alternatives will meet the objectives and provide a better end product to the utilities sponsoring this work. Alternatives shall be fully described including logistics explaining why the alternate works are being offered and the benefits to be realized by the funding utilities. Where alternatives are proposed, separate budgets shall be calculated for each alternative.

SUBMISSION OF PROPOSALS

The consideration of proposals received will be limited to those who indicate their intent to employ a suitable experienced project team and who possess proper facilities to perform the work. Receipt of this "IFP" does not necessarily constitute a prior determination by CEATI that your organization has the requisite experience and facilities.

The proposal must be properly completed and executed in accordance with the CEATI guidelines available at <http://www.ceati.com/guidelines.php>, and shall be submitted to CEATI as

an attachment in Microsoft Word at the following website: www.ceati.com/private/submissions. Be sure to indicate project number “**CESIG-10-01**” on the submission form. For assistance, please contact us at 514-866-5377 x 236.

CLOSING DATE FOR RECEIPT OF PROPOSALS

Thursday, April 8, 2010, 4:00 pm EDT