Request for Proposals

The 2009 International

Future Energy Challenge

A student competition sponsored by the

Institute of Electrical and Electronics Engineers (IEEE) Power Electronics Society

Summary of Competition and Proposal Requirements

General Information

Competition Title: 2009 International Future Energy Challenge Student Competition

Topic areas: (A) Integrated Starter/Alternator-Motor Drive for Automotive Applications
(B) Low Power Wind Turbine Energy Maximizer.

Period of Competition: Topic (A) - May 12, 2008 to July 17, 2009
Topic (B) - May 12, 2008 to July17, 2009

Challenge Award: At least US$10,000 (and more based on sponsorship) will be awarded for highest score among entries meeting all minimum requirements as confirmed through reports and hardware tests.

Program Awards (actual number depends on availability): Best in specific topic areas (engineering design, innovation, reports, undergraduate educational impact, presentations, and others); expected levels are $1,000 to $5,000 each. The final amounts are subject to the recommendations of the judges.

Intellectual Property and Use of Prize Money:
The International Future Energy Challenge does not restrict the use of third party inventions or intellectual property by participating teams. There are no special licenses or rights required by the sponsors. However, neither does the International Future Energy Challenge offer any form of protection of invention or intellectual property produced by participating teams. Participating teams should take note of the fact that the Finalist Competition Event for each topic represents public disclosure of their technology. Teams interested in securing protection for their inventions or intellectual property should take note of the date at which this will occur and take appropriate action beforehand.

The prizes provided to schools are intended to benefit the team members and student team design project activities. There is a Letter of Support (Attachment II) required for submission with the proposal, and it should outline the plans of the school in the event that a prize is received.

Outside Support:
Individual schools should solicit project funding from companies, foundations, utilities, manufacturers, government agencies, or other sources. There is no limitation for the sources of project funding.

Eligibility Information:

- **Eligible schools must:** Have an accredited or similarly officially recognized engineering program (through the Accreditation Board for Engineering Technology (ABET) or equivalent); Be a college or university with engineering curricula leading to a full first degree or higher; Have the support of the school’s administration; Establish a team of student engineers with an identified faculty advisor; Demonstrate the necessary faculty and financial support commitments; and Demonstrate a strong commitment to undergraduate engineering education through their proposal.

- **University Eligibility Limit: Each university is limited to one topic area; each school can support only one team.**

To confirm eligibility, potential participating schools must submit a Letter of Support (Attachment II) together with a Preliminary Team Information Form (Attachment I) when they submit the proposal.

How to Participate: Participation is on a proposal basis. Those schools that are interested must submit a proposal no later than **May 2nd, 2008**. Proposals will be judged by a distinguished panel of volunteer experts from the IEEE and from industry. Schools with successful proposals will be notified by **May 12th , 2008**. Student teams will then carry out the work and prepare hardware prototypes and reports. Organization reports are due **September 5th, 2008**. These reports will be reviewed by topic chairs. Progress reports are due **February 6, 2009**. Qualification reports are due **April 20th , 2009**. The reports will be judged by an expert panel similar to the initial proposal judging panel. By **May 4, 2009**, the panel will select a group of teams as Finalists. The finalists will be invited to a competition event that will take place during July 15-17, 2009 in Chicago, IL (Topic-A) and Melbourne, Australia(Topic-B). A Final Report must be submitted at the start of the competition event. The team achieving the overall results in this event that best meet the Challenge Requirements will receive an Award of no less than US$10,000 (or more depending on sponsorship levels). The best results in individual categories, including engineering design, engineering report quality, technical presentation, innovation, and other categories to be determined, will win special monetary prizes of approximately $1,000 to $5,000 each.

Please be aware that each of the two topic areas of the 2009 International Future Energy Challenge will be judged separately at different times and locations, against a separate specification set. Each team proposal must address a single topic area.

Judging Panels

Experts from IEEE Power Electronics Society, Industry Applications Society, Power Engineering Society (and others to be announced), and representatives from manufacturers, national labs, independent test labs, utilities, and R&D engineers.

Judging

Student team project results will be judged based on cost effectiveness, performance, quality of the prototype and other results, engineering reports, adherence to rules and deadlines, innovation, future promise, and related criteria. Each aspect of judging will be scored according to a point list and Test Protocol published in the 2009 International Future Energy Challenge Rules.

Proposals

Proposals will be judged on the quality of plans, the likelihood that a team will be successful in meeting the International Future Energy Challenge objectives, technical and production feasibility and degree of innovation. Other key criteria are evidence of the school's commitment, capability, experience, and resources to implement their design over the one-year span of the competition. Commitment to excellence in undergraduate education is important, and acceptable proposals will involve undergraduate students as the primary team members. Interdisciplinary teams are encouraged. Graduate students are not excluded, but the impact on undergraduate education is a critical judging criterion. **Proposals are limited to 12 double-spaced pages total, including all diagrams, attachments, and appendixes.** Schools that are invited to participate in 2009 International Future Energy Challenge are expected to adhere to the basic plans described in their proposals. Approval of the competition organizers must be sought for significant changes in plans or engineering designs. **Only one proposal will be considered from each school. Electronic copies of the proposals in PDF format are due, to be received by May 2nd , 2008, at the address provided below.**

A. Proposal Objectives

Respondents should express their ideas and plans relevant to their interested topic area. The project should include the construction and operation of a complete hardware prototype. The proposal must address both technical and organizational issues for each phase of the prototype's development and testing. It must contain a realistic project budget, along with a plan to secure the necessary funding. The educational goals, including any course credit provided for work related to 2009 International Future Energy Challenge, and how the project relates to other efforts within the school and at the regional or national level should be addressed. A Letter of Support from an official of the school confirming a commitment to participate in the competition, and stating the type(s) and level of support for the team's participation in the competition should be attached, and is not counted toward the 12-page limit. Refer to the attachments at the end of this document for a sample.

B. Administrative Considerations and Limitations

This section describes the limitations placed on the proposal. Compliance is mandatory.

Language	Proposals must be written in English.
Length	Proposals are limited to 12 single-sided double-spaced pages of text, figures, and appendixes. The page size must be 8.5" x 11" or A4 and the font size must be no smaller than 10 point. Margins should be at least 25 mm. The Preliminary Team Information Form (Attachment I in this RFP), Support Letter (Attachment II in this RFP) from the school, government entities, or private sector organizations will not count in the proposal length.
Authors	Proposals are to be prepared by the student team in collaboration with the faculty advisors.
Signatures	Proposals must be signed by all authors of the proposal (or the student team leader) and the faculty advisor.
Letter of Support	Proposals must be accompanied by a letter of support from an appropriate Dean, Department Chair, or other authorized school official. The letter must confirm the school's commitment to participate. It must also state the type(s) and value of support from the institution. School support should match the value of cash and in-kind support from the team's principal sponsors. Additional letters of support from other team sponsors are optional. A sample letter is provided as Attachment II.
Preliminary Team Data	Submit one copy of the Preliminary Team Information Form (Attachment I) with the proposal, then an updated copy with

the progress reports to the address below. This form does not count in the 12-page limit.

Due Date

All proposals must be received at the address below by close of business on May 2nd, 2008 for full consideration.

Proposal Submission

An electronic copy of the proposal in PDF format must be sent to the competition administrator. Email is the preferred medium. If necessary, the electronic version can be delivered on floppy disk (IBM format), Zip disk (IBM format), CD, or USB memory stick.

Competition Administrator:

Dr. Babak Fahimi
Chairman, 2009 IFEC
University of Texas at Arlington
416 Yates street
Arlington, TX 76019, USA
Phone: +1-272-2667
Fax: +1-272-2253
E-mail: fahimi@uta.edu

Information

The volunteer Organizing Committee for the 2009 International Future Energy Challenge maintains a web site at http://www.energychallenge.org/. The site will include the most recent schedule and rule updates, frequency-asked questions, details about judging and scoring, and other team information. It should be checked regularly. The committee chair is **Prof. Babak Fahimi**.

Coordinator for Topic (A)

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Coordinator for Topic (B)

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Calendar of Events

February 4, 2008	Request for proposals (RFP) posted
May 2, 2008	Proposals due
May 12, 2008	Schools informed of acceptance into the competition
September 5, 2008	**Organization** summary reports due (Organization reports are limited to 5 pages double-spaced, single-column pages total, including team organization, school support along with basic diagrams, attachments, and appendixes.)
February 6, 2009	**Progress** reports due (Progress reports are limited to 10 double-spaced, single-column pages total, including with basic diagrams, , preliminary experimental results, attachments, and appendixes.)
February 15, 2009	Workshop at APEC 2009, Washington DC
April 20, 2009	**Qualification** reports due (Qualification reports must include preliminary experimental results qualification reports are limited to 25 single-column pages total, including all diagrams, attachments, and appendixes.)
May 4, 2009	Finalists notified (Selection is based upon likelihood of deliverable hardware, quality of design, and likelihood of success in meeting all the challenge objectives.)
July 15, 2009	**Final** reports and working units due (Final reports are limited to 50 single-column pages total, including all diagrams, attachments, and appendixes.)
July 15-17, 2009	Final competition

2009 International Future Energy Challenge Organizing Committee

Chair: Dr. Babak Fahimi – University of Texas at Arlington
Coordinator Topic A: Dr. Antonello Monti – University of South Carolina
Coordinator Topic B: Prof. Grahame Holmes – Monash University
Industry Liaison: Dr. John M. Miller – J-N-J Miller Design Services, P.L.C.
Webmaster: Dr. Antonello Monti – University of South Carolina
Sponsor Liaison: Dr. John M. Miller – J-N-J Miller Design Services, P.L.C.
European Liaison: Dr. Francesco Profumo – Politecnico di Torino
Australia Liaison: Dr. Grahame Holmes – Monash University
South America Liaison: Dr. Marcelo G. Simoes – Colorado School of Mines

Competition Description

Scope: An international student competition for innovation, conservation, and effective use of electrical energy. The competition is open to college and university student teams from recognized engineering programs in any location. Participation is on a proposal basis.

Introduction: In 2001, the U.S. Department of Energy (DOE), in partnership with the National Association of State Energy Officials (NASEO), the Institute of Electrical and Electronics Engineers (IEEE), the Department of Defense (DOD) and other sponsors, organized the first Future Energy Challenge competition. The objective was to build prototype, low-cost inverters to support fuel cell power systems. This competition was originally open to schools in North America with accredited engineering programs. The 2001 Future Energy Challenge focused on the emerging field of distributed electricity generation systems, seeking to dramatically improve the design and reduce the cost of dc-ac inverters and interface systems for use in distributed generation systems. The objectives were to design elegant, manufacturable systems that would reduce the costs of commercial interface systems by at least 50% and, thereby, accelerate the deployment of distributed generation systems in homes and buildings. The 2001 Challenge was a success, and is now the first in a biannual series of energy-based student team design competitions.

To continue and expand the 2001 success, the 2003 Future Energy Challenge was organized as a worldwide student competition. The theme of the 2003 Future Energy Challenge was "Energy Challenge in the Home." The objective was to introduce engineering design innovations that can demonstrate dramatic reductions in residential electricity consumption from utility sources or that can lead to the best use of electricity in newly connected homes in developing nations.

To continue and expand the 2001 success, the 2003 International Future Energy Challenge (IFEC) was organized as a worldwide student competition. The 2003 IFEC had two topics, a revised topic on fuel cell power conditioning, and a topic for high-efficiency motor drive systems suitable for home appliances. Major sponsors included three IEEE societies, DOE, and DOD. Fuel cell inverter events were again held at NETL. Motor system events were held at Advanced Energy in Raleigh, NC, USA.

The 2005 IFEC had two topics. The inverter topic was revised to incorporate photovoltaic sources and grid interaction, while the motor topic was revised only slightly. Major sponsors included three IEEE societies and DOD, with more modest sponsorship from DOE. Inverter events were held at the National Renewable Energy Laboratory (NREL) in Golden, CO, USA. Motor events were held at MPC Products in Skokie, IL, USA.

The 2007 IFEC had two topics. An integrated starter/alternator and a Universal battery charger system were chosen as the two topics. Major sponsors included IEEE Power Electronics society, and Power Supply Manufacturer Association (PSMA). The final competitions were held at MPC Products in Skokie, IL and Texas Instrument in Richardson, TX.

2009 Topics and Descriptions: The 2009 competition addresses two broad topic areas:

(A) Integrated Starter/Alternator-Motor Drive for Automotive Applications.

(B) Power Wind Turbine Energy Maximizer

Detailed specifications, system requirements, and test procedures for each of the two topics will be updated through July 2009 through the IFEC Web page.

Detailed Description, Proposal Preparation, and Specifications of Each Topic

Request for Proposals- Topic (A) Integrated Starter/Alternator-Motor Drive for Automotive Applications

The main purpose of this challenge is to conceptualize, design, and develop a 1 kW, 3000 rpm electromechanical energy converter for operating efficiently (not less than 75% at cruising speed not including losses in the testing interface) as a generator and motor. It is also desired to have a (cold) stand still torque of 30 N-m, for duration of 3 to 5 seconds, to accommodate the starter requirement. The motor shall start under an initial load of 30 N-m and reach the speed of 3000 rpm within 3 to 5 seconds (see Figure 1 for a qualitative power requirements vs time). Design should assume the existence of an adequate 200 Volts dc link. Following the startup process, the electromechanical energy converter should quickly and safely become an alternator, charging a set of batteries at cruising speed of 3000 rpm. The desired controller should receive and monitor an stream of data (in analog or digital format) which includes the mode of operation (motoring/generating) along with the desired level of power. The motoring action is assumed as an adjustable speed option ranging from standstill to the cruising velocity. The main objectives are:

- Cost. A target cost of $100/complete setup (including electric machine and controller) is considered for mass production.
- Safety and fault tolerance. Development of fallback strategies in the event of failures in machine, converter, and sensors are highly encouraged.
- Efficiency. A target efficiency of not less than 75% during motoring and generating (not starting) modes of operation is required.
- Packaging.
- Smoothness in transition from motoring to generating and visa verse. This will be gauged in terms of quickness of the process, absence of mechanical bumps and irregular electromechanical transients.
- Innovativeness in magnetic design and power electronic-based controller.

An adequate dynamometer will be used to apply the necessary torque profiles to the shaft of the machine. Figure 2 illustrates the general configuration of the testbed. As can be seen a dc power supply (200V dc) and a 1 kW, 200V resistor bank will be provided. However, controllable switches for switching from motoring to generating modes of operation are considered as part of test hardware by the competitors.

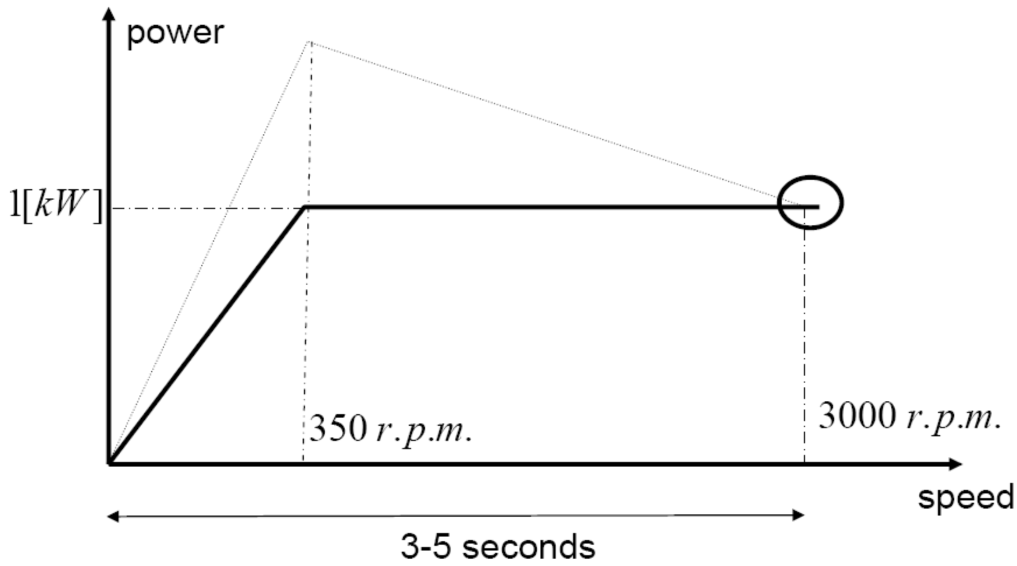

Figure 1: Evolution of the power requirements vs time during the starting transient

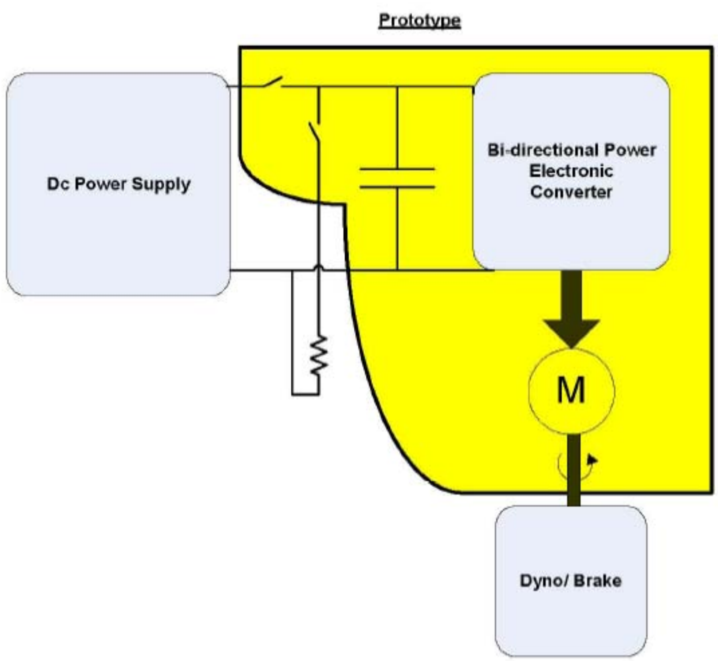

Figure 2: General schematic of the test motor, the highlighted area illustrates the required hardware from competitors

What follows is a summary of requirements for the alternative drive system:

Design Concept	Requirements
Manufacturing Cost	**Not more than $100 for machine and controller in a mass produced environment (1Million prototypes per year)**
Package size	**Not to exceed NEMA frame 56**
Package Weight	**Not to exceed 10kg**
Output power capability	**1kW at 3000 r.p.m. (motoring or generating)**
Cold torque capability	**30N-m**
Input Supply	**200V dc**
Overall efficiency	**Not less than 75% overall efficiency during motoring or generating at 3000 r.p.m.**
Speed control	**Speed should be controllable in motoring mode of operation from standstill to 3000 r.p.m.**
Safety	**The drive system should be safe enough to be used in an automotive environment. Development of fault detection and fault management algorithms will be viewed favourably.**
Acoustic noise	**Low noise during motoring and generating. An acoustic noise less than 60db is encouraged.**
Electromagnetic noise	**It should meet FCC class A requirement.**
Protection	**The drive system should be devised with a shut-off button to turn off the entire system safely. It should protect itself from stall conditions, over temperatures.**
Life time	**System should function for at least 10 years.**
Technical Report	**Simulation, experimental results, life time analysis, and cost study.**

Request for Proposals – Topic (B) Low Cost Wind Turbine Energy Maximizer

Objectives:

- Encourage the development of technologies to bring dramatic improvements to low-cost low-power wind generation systems for small distributed generation applications.
- Encourage the increased use of alternative energy electrical generation systems.
- Incorporate practicality, potential manufacturability, and affordability into the competition assessment process.
- Demonstrate technical progress toward and potential of advanced technologies that may help achieve the goals of this competition.
- Improve engineering education and foster practical learning through the development of innovative team-based engineering solutions to complex technical problems.
- To promote power electronics as exciting and relevant to real world problems.

Topic B Goal

Construct a power electronic interface converter for a wind generation system that will:

- Support and protect the system operation under all operating conditions.
- Achieve maximum energy transfer when charging a 12V battery over a wide range of wide speeds, without overcharging or damaging the battery;
- Reliably operate without significant user support over many years of use;
- Be a leading edge solution in the areas of performance, reliability, and safety.
- Design for minimum weight, minimum component cost and count, to achieve reduced high volume manufacturing cost.

Background

The objective of this topic is to foster innovation in low power wind turbine generation systems for remote, rural and small urban applications.

Low power wind turbines are used in a wide variety of applications, ranging from powering remote monitoring and telecommunication stations, to rural farm pumping stations, to ocean cruising yachts. Commonly, they are used to charge 12V or 24V battery systems, often in conjunction with a solar panel installation and (for larger systems) a backup diesel generator. More recently, small scale wind turbines are being considered for domestic/urban situations, such as the spire of St Martha's shown in Figure 1. These turbines are operated in a similar fashion as domestic solar photovoltaic panels, to provide renewably generated electrical energy to supplement the conventional grid supply.

Figure 1: Urban turbine - the spire of St Martha's. Credit: Allan Joyce Architects. A wind turbine was incorporated into the spire of St Martha's Church on the Broxtowe Estate in Nottingham, UK.

A major challenge for any wind turbine is how to manage the large variation in wind speeds that occurs as the weather changes. Larger wind farms choose their location carefully to reduce this influence, and incorporate complex turbine control and/or power interface systems that match the turbine operating condition to the available wind speed to maximize the energy extracted. Unfortunately, these options are not usually viable for low power turbines – the turbine location is usually determined by factors other than the available wind, the generators are usually permanent magnet motors with a fixed generation characteristic, and cost is always a major constraint for low power renewable generation systems.

The challenge for Topic B is to develop a low cost interface converter that will maximize the energy fed into a 12V battery from a 300W domestic wind turbine system when it operates over a wide range variable wind regime, without damaging the battery, generator or turbine.

Wind Turbine Operation

All wind turbines have an optimum operating point which maximises their power output for a given wind speed, as shown in Figure 3. For any particular turbine, this operating point is maintained as wind speed varies if the turbine is controlled to operate at a constant tip-speed ratio (TSR), i.e. the ratio of the blade tip speed to wind speed.

Turbine operation on the right hand side of optimum TSR is a stable operating position, since a reduction in turbine speed will increase the generated power and restore equilibrium conditions. Turbine operation on the left hand side of optimum TSR is inherently unstable, and can lead to turbine stall as operating conditions change.

Figure 2: Typical Wind Turbine appropriate for the 2009 IEEE FEC Topic B system. www.jaycar.com.au 8/1/2008

For the Future Energy Challenge, the maximising converter is required to control the turbine output power to match the battery charging requirements as both wind speed and battery charge condition vary. When the battery is not fully charged, the required strategy is to extract the maximum possible turbine power as the wind speed varies and feed this to the battery, provided the battery charge current limits are not exceeded. When the battery is fully charged, the converter is required to reduce the power fed to the battery to avoid overcharging, either by varying the turbine TSR operating point, introducing a dump load to dissipate the extra power, or any other strategy a team may propose.

A further issue to be considered is very high wind speeds, which can cause the turbine to overspeed. This can create a very high generator output voltage which may damage the interface converter, and extreme winds may also create such high centrifugal forces on the blades that they are torn off at the roots. The controller is required to detect and prevent this hazard.

Turbine/Generator Specifications

While the controller should be designed to interface to any wind turbine of appropriate rating, the turbine on which the competition finals tests will be conducted has the following specifications:

1. Rated output power: 200W at wind speed of 8m/s (TBA)

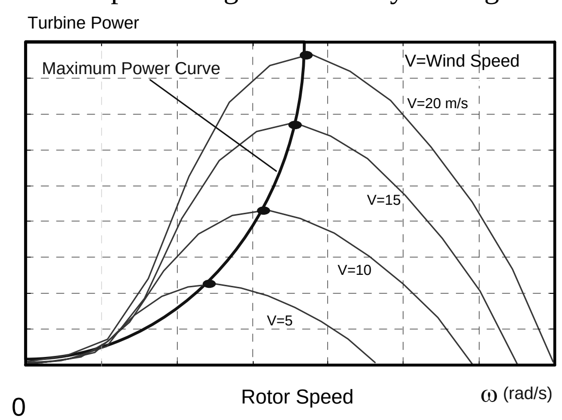

Figure 3. Speed-power curves for a wind turbine for different wind speeds.

2. Maximum allowable output power: 300W at wind speed of (TBA) m/s
3. Absolute withstand wind speed: 40m/s
4. Generator type: permanent magnet, 3-phase, (TBA) poles,
5. Generator output: 3-phase AC, (TBA)V/rpm
6. Rated output current: 8.33A
7. Mechanical time constant: 10 seconds (TBA)
8. Rotor diameter: 2.1m
9. No. of blades: 3
10. Starting wind speed <3m/s

NOTE: The turbine does NOT provide any separate form of speed sensor to the controller.

General Converter Requirements

The following specifications are intended to provide guidance rather than an exhaustive list of requirements. All teams are encouraged to develop novel solutions and test a wide range of ideas. The long-term purpose is to develop cost-effective technologies that will bring major advances for the control of low-power wind turbine systems. Judges will be encouraged to consider the spirit, innovation, and future promise of each team's work when reviewing entries.

The inverter system proposed will be judged against a set of objective specifications based on the example design targets shown below. The design concept is for a nominally rated system, and teams are expected to construct a complete working hardware prototype to demonstrate their accomplishments. The target design requirements for the system given below are minimums that need to be reached to win the Challenge Award. Design concepts are expected to be validated with working prototypes. Scoring will be set up such that improvements beyond the minimums are beneficial to the team.

The general converter functions and requirements are:

1. Maximise the energy supplied to the battery from the wind turbine when the battery is not fully charged.
2. Avoid overcharging the battery.
3. Suit 12V lead acid battery.
4. Protect the wind turbine from over-current, over-voltage and over-speed.
5. Design to suit minimum cost for high volume manufacture.
6. Operate over a wind speed range of (TBA) m/sec to (TBA) m/sec.
7. Comply with all relevant IEC and IEEE Standards.

Bonus Points

1. Innovative strategies to protect the turbine against overcharging and over-speed that do not require dump or emergency loads.
2. Power the converter from the wind turbine side.
3. 12V or 24V battery operation.
4. Operation when generator output voltage is less than the battery voltage.
5. Naturally cooled (no fan required)
6. More advanced battery state of charge management strategy
7. Operator display and keyboard to allow system status to be monitored and controlled

Minimum Converter Specifications

Design Item	Minimum Target Requirement
1. Manufacturing cost	*Parts cost of less than US$20 at high-volume production (approximately 100000 units/year)*
2. Complete package size	*A convenient shape with volume less than 2 dm^3 (2 liters).*
3. Complete package weight	*Mass less than 3 kg.*
4. Output power capability	*Must be able to deliver 300W of energy into a 12V battery continuously.* *Must be able to deliver 900W of energy into a 12V battery for 60 seconds.*
5. Peak power rating	*600 W peak (to be confirmed)*
6. Improved overall efficiency curves	*Should be included in the final report showing efficiency higher than 90% for power level varying from 5% to 100%.*
7. Stand-by (tare) losses, i.e., when inverter is on, but not producing power (low load).	*When the wind turbine is not producing power, the converter should shut down controllably.*
8. Input source	*A permanent magnet generator driven to simulate a measured wind speed regime. The generator output will be 6 Vrms to 50 Vrms as the simulated wind speed varies (to be confirmed).*
9. Load	*The converter will be supplied with a 12V battery load. Designs that require a dump load must provide their own dump load.*
10. Battery Management	*Protection against battery overcharging*
11. User Interface	*Minimum indicator and controls required for safe operation*
12. Overall energy efficiency	*Higher than 90% for a 200W load. Additional scoring points will be awarded for efficiencies above 90%.*
13. Protection	*Over current, over voltage, short circuit, over temperature, under voltage. No damage caused by output short circuit. The converter will be short circuit tested at the Finals competition. The converter must shut down in a safe mode if the input voltage dips below the minimum input. IEEE Std. 929 is a useful reference.*
14. Electromagnetic interference	Per FCC 18 Class A -- industrial requirements for conducted and radiated EMI.
15. Acoustic noise	No louder than conventional domestic refrigerator. Less than 50 dBA sound level measured 1.5 m from the unit.
16. Safety	The final rules will contain detailed safety information. No live electrical elements are to be exposed when the unit is fully configured. The system is intended for safe, routine use in a home, rural or small business by non-technical customers. Compliance with industry safety standards will be required, such as UL 1741-2000.
17. Environment	*Suitable for outdoor installation up to 70C ambient temperature. Case should be resistant against heavy rain and rodents.*
18. Storage temperature range	-20°C to +75°C
19. Operating ambient temperature range	-20°C to +60°C
20. Ambient humidity	Humidity less than or equal to 95% up to 40 °C
21. Enclosure type (suggested)	NEMA 3R
22. Cooling	Air cooled
23. Shipping environment	Must be able to be shipped by conventional air or truck freight. Team submissions will be assessed for their ability to be shipped before unpacking on the first test day.
24. Lifetime	The system should function for at least 10 years with routine maintenance when subjected to normal use in ambient environment.
25. Technical report	Design, simulation, experimental results, overall efficiency, lifetime analysis, and cost study. The report must include reliability and cost analysis to demonstrate that the design can meet the ten-year lifetime requirement and the life-cycle cost objectives.
26. Grounding	If the case is metal, a grounding connection must be available. Note one of the battery connections may be earthed.

Final Testing

Final testing of the winning designs will be conducted July 15-17, 2009 at Power Laboratories, Dept ECSE, Monash University, Australia.

Initial Tests will be conducted using a turbine generator mounted on a motor test set and driven to simulate various wind speed regimes.

Final tests will be conducted using a complete wind turbine installed in a large wind tunnel, and driven with a fluctuating wind speed regime.

Maximizer converters will be assessed for their ability to operate reliably under a variety of simulated wind conditions, and for the amount of energy they are able to extract from the wind turbine under a given test regime.

Funding Sources

IEEE and other sponsors provide the Challenge Award as well as the Program Awards.

Individual schools should solicit project funding from local, national, or international sources. There is no limitation for the sources of project funding.

Information still to be supplied

Range of appropriate turbine TSR characteristics
Range of generator open circuit and short circuit characteristics
Range of wind regimes required to be able to support
Operating conditions for the turbine/generator that must be avoided at all costs

ATTACHMENT I

2009 INTERNATIONAL FUTURE ENERGY CHALLENGE
PRELIMINARY TEAM INFORMATION FORM
TOPIC (X)
Submit with Proposal

NAME OF UNIVERSITY:

CORRESPONDING ADDRESS (PLEASE INCLUDE NAME):

TELPHONE:
FAX:
EMAIL:

FACULTY ADVISOR(S):

Name	Department	E-Mail
____________________	____________________	____________________
____________________	____________________	____________________

PRELIMINARY TEAM MEMBERS:

Name Major Field of Study Degree and Expected Graduation Date

Name	Major Field of Study	Degree and Expected Graduation Date
____________________	____________________	____________________
____________________	____________________	____________________
____________________	____________________	____________________
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ATTACHMENT II
LETTER OF SUPPORT
Submit with Proposal

[The letter below is a typical sample and should not simply be copied. Please send a letter with similar content on your university letterhead.]

For Topic (A):……………………………………………………

To: Prof. Antonello Monti
Prof. Antonello Monti
Department of Electrical Engineering
University of South Carolina
Phone:+803 777-2722
Fax: +803 777-8045
Email: monti@engr.sc.edu

For Topic (B) :…………………………………………………….

To: Prof. Grahame Holmes
Department of Electrical and Computer Systems Engineering
Faculty of Engineering
PO Box 35
Monash University, VIC, Australia
Phone: +613 9905 3473
Fax: +613 9905 9606
E-mail: grahame.holmes@eng.monash.edu.au

Dear International Future Energy Challenge Coordinator,

Our university has organized a student team to participate in the 2009 International Future Energy Challenge. Our proposal for the topic (X) is enclosed. A Preliminary Team Participation Form is attached, listing our contact person, the faculty advisor(s), and some of the students who plan to be involved. The team will keep an eye on the Energy Challenge web site for detailed rules and other information. We understand that we will be notified whether we have been accepted to participate by May 12, 2008. If we are accepted, we agree to have our student team perform the design tasks and prepare the reports and hardware prototypes required for the competition. Our school is prepared to support the team with the following resources:

- A final year project course, XXX, has been authorized to provide engineering students across several disciplines with the opportunity to include this project in their curricula. Laboratory space has been arranged for this course.
- A faculty advisor, Prof. XXX, has been identified, and has been formally assigned to teach the project course and to advise the student team as a portion of her regular duties.
- A graduate student assistant has been identified to help manage the student team and to supervise direct laboratory activity. This student is supported with a Teaching Assistantship, which represents a funding commitment of our university of approximately $X.

- The student team will be provided with an appropriate level of technician and machine shop support to assist them with package preparation and assembly. This assistance represents a funding commitment of approximately $X, and we consider this as a matching commitment for any in-kind support received from external sponsors.
- In addition, we will provide limited funds to help secure special parts and equipment, with a total commitment of up to $X.
- The student team will be encouraged to secure outside sponsorship. Our university strongly supports all these efforts, and will match any outside cash support 1:1 up to an additional total of $X.

In the event that our school receives prizes from the competition, we are committed to using approximately X% of this money for scholarships for the student team members. The remainder of the funds will be added to our Team Design Program fund, which supports this and similar projects through sponsorship matching, travel funds for participation in competition events, and other direct costs of large team design projects. In the event that our team creates new inventions in the topic area, our university also provides the possibility of assisting with organization of a start-up company.

We understand the importance of student team projects in the engineering curriculum and look forward to our participation in the 2009 International Future Energy Challenge.

Sincerely,

(Head of Department, Dean of Engineering or similar school official)