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Mr. Bob Hanna
Chief Technical Advisor
Department of Communications, Marine and Natural Resources
Adelaide Road
Dublin 2
20th May 2005

Dear Bob

Re: Energy Research, Development and Demonstration: Consultation Paper

This is the response of the Electricity Research Centre (ERC) to the consultation paper on Energy Research, Development and Demonstration (R,D & D). We welcome the consultation paper and our response is structured as follows.

- A summary of the ERC response.
- Some contextual background on the ERC setting out its objectives in the energy R, D & D area and a number of appendices with further details.
- Some general observations on energy R, D & D.
- A response to the specific issues raised in the consultation paper.

All members of the ERC, with the exception of the CER, endorse this response and some have made separate response to this consultation paper which addresses their specific concerns.

Summary

- The energy industry is currently undergoing significant change which highlights the urgent need for R, D & D.

- Through its activities, outputs and growing industry membership the ERC is widely recognised as an extremely strong energy research entity and is ideally placed to respond constructively to the consultation paper.

- Funding should be allocated on the basis of a competitive process.

- We believe that the emphasis should be on research in targeted areas where Ireland has particular needs and/or competitive advantage.

- A rigorous assessment of all existing and future energy R, D & D activities is required to ensure value for money.

- To encourage excellence in energy R, D & D funding should only be allocated to those who meet and/or exceed a high benchmark of performance.

- Industry participation at all levels of the R, D & D activity is imperative and ways should be found to underpin and develop more energy industry in Ireland, in particular in the private sector.

- We are in favour of the establishment of an Energy Research Coordination Council, possibly on an all island basis, serviced and/or advised by Science Foundation Ireland, with responsibility for both technical and policy research.

- We are in favour of further collaboration and coordination in energy research with colleagues in Northern Ireland.

- The ERC is keen to participate in and influence EU research programmes where they bring net benefits to Ireland.

- We are in favour of coordination with environmental research.

- A balance between long term and short term research is important and requires appropriate support and capacity building.

- There is a need for significant funding in energy research, coordinated with capacity building and this can be provided by halting ineffective existing programmes, coordination and additional resources.

- Capacity building in key disciplines can be achieved by long term research funding.

The ERC

The ERC was established in 2001 as collaboration between the Power Systems Research Group[2] at University College Dublin and significant elements of the Electricity Industry in the Republic of Ireland. The industry participants are, ESB National Grid, ESB Networks, ESB Power Generation, the Commission for Energy Regulation and Cylon Controls[3]. Recently Airtricity have joined the ERC and we are in membership discussions with Viridian and have begun the process of involving Areva and other manufacturers. Therefore the industry membership of the ERC spans all activities within the Electricity Industry from regulation, generation, transmission, distribution and the consumer. The primary goal of the ERC is to carry out research in topics of interest to the electricity industry. Where feasible and through appropriate collaborations the ERC is keen to explore the possibility of expanding its research activities beyond the electricity area and into the broader energy area. Four major challenges motivated the establishment of the ERC:

- Markets: The recent introduction and evolution of competitive electricity markets.
- Environmental: The need to reduce green house gas emissions.
- Infrastructure: Economic growth in Ireland has stretched the electricity infrastructure to its limits.
- Skills: There is a recognised skills shortage in the industry.

To date the total committed funding secured is €1.059M over five years made up of €0.556M from members and €0.535M in matching funds from for example Enterprise Ireland (EI). The next five year funding cycle will begin in 2006 and the ERC will be seeking a minimum of €2M funding from its members and other sources. This increase reflects the need to keep pace with the demand for the ERC activities and the need to build research capacity. Professor Mark O'Malley is the Director of the ERC (Appendix I) and the current research team consists of one part time visiting academic, three post docs (two part time), five PhD students, one Masters student (part time) and a part time administrator (details in Appendix II). The ERC is actively involved in a number of national and international research collaborations detailed in Appendix III. Research topics in the ERC include:

- Frequency control and reserve in small isolated power systems.
- Wind turbine modelling for power system studies.
- Operation of power systems with significant amounts of wind power penetration.
- Demand side management applications in particular real time flexible load control.
- Emissions reduction with renewable generation on electric power systems.
- Optimal development of electrical distribution systems with increasing deployment of embedded generation.
- Policy questions concerning renewable generation.
- Impact of tidal stream energy devices on electric power systems.

[2] The Power Systems Research Group was established in 1991 with funding from ESB National Grid. Therefore the ERC is a logical evolution of the Power Systems Research Group with a broader support base.

[3] An Energy Management Company established in 1985 that started as a University College Dublin campus company see http://www.cylon.com/

- Optimal plant mix for future electricity systems.

The primary research outputs of the ERC are postgraduates and publications in the IEEE Transactions on Power Systems which is recognised internationally as the highest impact journal in power systems research. Further details of research outputs are given in Appendix IV. The ERC is also actively involved in providing consultancy and educational services to the Irish electricity industry; host distinguished visitors and arranges public seminars and lectures on topics of interest within the electricity industry (details in Appendix V).

The future research direction of the ERC will be driven by the twin principles of strategically important areas for Ireland and targeted areas where we can compete internationally. Optimal plant mix for the future electricity system is a theme that we believe captures both of these principles. The three main drivers for national energy policies today are security of supply, environmental impact and competitiveness of industry. The tradeoffs and interactions of these three are complex and challenging and are encapsulated in the future optimal plant mix question. The optimal plant mix question when properly formulated encapsulates many power system and economic research areas. The ERC and its collaborators have existing research strengths in many of these areas. One of these areas concerns grid integration of renewables and wind power in particular. The ERC believe that this is a area where Ireland can compete internationally and can develop commercial activities to our advantage.

It looks increasingly likely that wind energy will play an increasingly important role in the future of the electricity system in Ireland. At current growth rates, Ireland as a single synchronous system, is perhaps approaching one of the highest wind penetration levels in the world. This gives us the opportunity to grasp a competitive advantage over others. On the island of Ireland we are facing issues now that other systems will face in the future and we are gaining a lot of experience in this area. The ERC believe that the island of Ireland presents an interesting model of what will happen on other systems as their penetration levels rise. We believe that the system presents an excellent location for exploring the issues of integration and penetration of wind energy and other forms of embedded generation. Given its size, small but not insignificant, it is potentially a test bed for many of the future developments and properly managed and resourced gives Ireland a competitive advantage in developing commercial activities in this area.

Through its activities, outputs and growing industry membership the ERC is widely recognised as an extremely strong energy research entity and is ideally placed to respond constructively to the consultation paper.

General Observations

Recent fuel price hikes the evolution of markets for electricity and emissions, the rapid growth in wind power and security of supply issues all underpin the strategic importance of technical and economic energy R, D &D.

We agree with the consultation paper that funding should be allocated by a competitive process. Competitive processes in R, D & D activities indicate, for public funds, an international peer review system. The international peer review process is universally accepted and recognized as the best guarantee for developing a sound and

sensible R, D & D strategy. Industry have an internal peer review process for the allocation of research funding that is competitive and more focussed on specific objectives. Both approaches complement each other and when done in a coordinated manner can lead to very effective use of resources.

The title of the document "Energy Research, Development & Demonstration" covers an extremely broad area potentially ranging from research into nuclear fusion to the domestic demonstration of an energy saving device. It is simply not credible for a country the size of Ireland to participate in and contribute meaningfully to such a range of activities. Furthermore we believe that world class research today is multifaceted, multidisciplinary with few boundaries and the distinction between research, development and demonstration may not be meaningful. We believe that Ireland should participate in those areas where it has particular national needs[4] and/or where it has a competitive advantage[5].

The consultation paper has an appendix which indicates that there is modest energy R, D & D activity in the country. However it is unclear how well this is performing and how effective the resources being deployed are and if value for money is being achieved. We believe it is necessary for any Energy R, D & D activity to be properly assessed at all stages, i.e. prior to funding, during the activity and after it is completed. A rigorous assessment of existing R, D & D activities would in our view be a useful exercise which would inform future activities and highlight weaknesses in any existing programmes.

Ireland is a relative newcomer to serious research activity and there is a serious dearth of experience at all levels. This not only includes the capacity of the system to carry on the activities but the ability to manage and administer the activities. The energy research community is so small in Ireland that conflicts of interest will be difficult to avoid and competitive allocation of funding may be difficult as there are so few worthy recipients. It is not envisaged that competition for funds will be between individuals and/or groups but rather it will be against some predefined benchmark. We believe that these benchmarks need to be set high and that no attempt should be made to allocate funding to individuals or groups below the bar. This will encourage unsuccessful individuals and groups to raise their standards and/or will encourage the influx of outside talent. Either outcome is desirable for the long term success of energy R, D & D.

The success of the ERC can be attributed to its industry members. Their participation and support have maintained the focus, relevance and innovation of the ERC activities. We passionately believe that their participation at all levels of the R, D & D activity is imperative. They bring credibility and are best placed to identify the strategic needs of energy R, D & D in Ireland. The ERC currently has two member companies from the private sector, Cylon and Airtricity, and are actively pursuing two more (Viridian and Areva). We are in favour of more private sector involvement and through schemes such as those run by Nova[6] at University College Dublin we would be supportive of the development of energy related companies either through collaboration with existing companies or through the development of start ups.

[4] For example, optimal plant mix
[5] For example, grid integration of wind power.
[6] Nova UCD is the new Innovation and Technology Transfer Centre at University College Dublin.

Specific observations

Institutional and governance options

The ERC is currently run by a board made up of a representative of each of the industry members. The board is chaired by one of the industry members and meets approximately four times a year. Representatives of some other organisations attend as they have an interest in the activities of the ERC but are not members e.g. Prof. John Fitz Gerald of the Economic and Social Research Institute (ESRI). We find that this structure works well and have recently considered adding an independent chairman. Therefore the ERC favours the Department's preference for the establishment of an Energy Research Coordination Council provided a number of key principles outlined below are followed in establishing the council.

- The council is chaired by an independent individual.
- The council seeks ways and means of coordinating its activities with the broader research agenda in the country.
- The individuals on the council are people who, at a minimum, understand R, D & D and are acting in a personal capacity i.e. do not have an agenda dictated by their parent organisation. Conflicts of interest may arise and need to be managed carefully.
- The council has several international members, individuals with a distinguished research career in energy.
- Members of the council give significant time, particularly preparation time to the council activities. Serious consideration should be given to compensating people for their time.
- The council should be a balance between industry, academia and policy makers and should have a significant representation from Northern Ireland.
- We believe that many existing R, D & D activities should be added to the portfolio of this new energy research coordination council, in particular all existing government initiatives.
- In keeping with a light handed approach proposed in the consultation paper the council should support and encourages existing successes.

The ERC believe that Science Foundation Ireland (SFI) is eminently suited to service and/or advise the Energy Research Coordination Council and would be strongly in favour of their participation. SFI has through the leadership of Dr. Bill Harris brought to Ireland the ethos of funding research through the competitive international peer review process with a minimal bureaucratic overhead. It is the ERC's opinion that in time a loose alliance of research funders will evolve in Ireland with SFI at the centre resulting in an Irish equivalent of the National Science Foundation in the US with responsibility for a broad range of research activity across all areas of Science,

Engineering and Technology. Therefore involving SFI at this stage in energy R, D & D may be helpful in the overall research strategy for Ireland. Some areas of SFI current funding may be applicable to energy research activities and these potential synergies should be harnessed.

We considered other organisations that could service the Energy Research Coordination Council. However we found them all to be unsuitable when tested against our needs in particular a competitive international peer review process with limited bureaucracy that would be supportive of the research community. Having more than one body servicing this council would be counter intuitive to a light handed coordination role that is envisaged for the council.

The ERC has a growing collaboration with energy policy research bodies and in particular with the ESRI. We are in favour of bringing technical and policy research under one coordinating body provided they are treated equally. We also believe that a centre of critical mass should be built in the country where technical and policy researchers work together across a broad range of energy research issues and would favour some attempt to form a loose "Energy Research Centre". Initially we favour establishing the strong individual groups around their speciality before embarking on a larger coordinating effort. A large research grouping can hide weaknesses within the group that are not desirable in the early stages of growing and strengthening energy research in Ireland.

All Island Perspective

The ERC is actively involved in all island activities. The ERC has a very active collaboration with the School of Electrical and Electronic Engineering[7] at the Queen's University Belfast (QUB). Dr. B. Fox of QUB is currently spending part of his sabbatical in the ERC and is receiving support from the ERC. Mr. G. Bryans is a PhD student in the ERC, part funded by the ERC and supervised by Prof. M. O'Malley (ERC) and Dr. B. Fox, Prof. P. Crossley and Prof. T. Wittaker of QUB. Ms. J. Ritchie is a PhD student in QUB who was part funded by the ERC. The ERC also has significant links with the electricity industry in Northern Ireland, in particular System Operator Northern Ireland.

It is the view of the ERC that much of the research activity in electricity is particularly suited to an all island approach and would be supportive of further collaboration and coordination provided there are no disadvantages e.g. no undue administrative burden. Research funding in the United Kingdom is significantly more mature than funding in the Republic of Ireland and much could be learnt from there. The possibility of the Energy Research Coordination Council having an all island mandate could be considered.

[7] In the last Research Assessment Exercise (RAE) in 2001 the school achieved a 5A rating which puts it among the elite schools/departments in Electrical & Electronic Engineering in the United Kingdom. The Republic of Ireland does not have an equivalent of the RAE which is a serious handicap to developing a world class research activity as students, industry and the public at large are generally unaware of the quality difference between academic departments and are therefore making ill informed decisions regarding choice of courses and research partners to the detriment of all concerned .

EU Perspective

The Director of the ERC has had experience of EU research activity. His experience was not positive. It is overly bureaucratic, a proper peer review process is lacking and there is a large travel overhead in coordination across multiple European partners with significantly different ethos and ability. A recent report from the EU on Frontier Research[8] supports this view and quantifies the poor performance of the EU in research when compared with our competitors, in particular USA and Japan. The consequence of this experience coupled with the capacity limitations within the ERC resulted in the ERC not actively seeking out EU research activities in the early years of the ERC. EU research activity has evolved over the past number of years and the ERC did participate in a large (40 partners, €50M) unsuccessful funding proposal called NEXTGEN on "Next generation of a smart, competitive and sustainable distributed electrical grid" under the 6th framework programme. More recently the ERC has driven an all island initiative to influence the 7th framework programme and the establishment of a technology platform in future electricity grids (details in Appendix VI)[9].

With some level of reservation, the ERC is generally supportive of EU research activities and is keen to participate where appropriate. However we believe that some of the EU activities may be wasteful of scare national resources and would be alarmed if participation in such activities were to be deemed highly desirable and/or necessary to acquire local funding. We would be highly supportive of a strategy where Ireland tried to influence at an early stage research activities in the EU so that the resulting programme was based on a proper peer review process and had elements that were clearly of benefit to Ireland.

Links with the environment

We believe there are significant opportunities for coordination between environmental research and energy research. We suspect environmental research may have similarities from a coordination perspective and believe that a comparable consultation exercise may be beneficial in the environmental area. We would be extremely supportive of coordination between energy and environmental research but would not wish this coordination to add unnecessary bureaucratic burden or delay any positive action arising out of this consultation. It would be important that environmental research and energy research adopt similar approaches to make coordination easier.

There are other potential links that may need to be considered, for example the Marine Institute and tidal energy. Tidal is an emerging renewable source of energy and one that the ERC with its colleagues in the Queen's University Belfast has an active interest in.

[8] European Commission, "Frontier research: The European Challenge: High Level Expert Group report", 2005.
[9] We found out today, 20th May 2005, that our initiative was successful and Mr. Paul Smith of ESB National Grid has been asked to join the advisory council.

Long-term vs. short term goals

The ERC research activities range from short to long term. Long term funding certainty and groups with critical mass are the keys to success in long term research. It is important that funding is supportive of this, the means of allocating is fair and rigorous and that there is confidence among researchers to build their careers in Ireland. PhD student research projects tends to tackle longer term goals and funding mechanisms need to recognise this. Short term goals are by their nature easier to identify than long term goals. Long term research activities are necessarily speculative and higher risk. However we believe that, provided the areas can be identified as of strategic importance to Ireland and/or are targeted areas where we would have a competitive advantage[10], the risk is reduced and value for money can be obtained.

Funding

The appendix to the consultation paper and the SEI R, D & D spend would indicate that there is significant funding in the area of energy R, D & D. However, as mentioned previously there is no measure of quality and in addition some of the items listed in the appendix would not in our opinion qualify under any reasonable R, D & D definitions and certainly very few would qualify under the heading research. The ERC's own funding comes from multiple sources, mainly from government bodies, state agencies[11] and private industry. Our success in attracting research funding is based on a matching funds principal. Any funds that we receive from industry we use to leverage other funds under programmes such as the Innovation Partnership scheme run by EI. Where pragmatic and appropriate, all state funds should be leveraged by money from industry as this will increases the chances that the work being carried on is relevant and that the research questions being asked are real and significant. The activities of the ERC are only limited by its capacity and there has been no difficulty in attracting sufficient research funding. It is our opinion that high quality research capacity cannot exist in the absence of significant research funding. It is pointless investing additional resources into energy research when there is a lack of research capacity as there will be no deserving place to allocate the funds. There is, in our view, a need for the coordination of increased research funding and capacity building in energy research. Funding can be harnessed by halting ineffective existing programmes, coordination and additional resources

[10] For example grid integration of wind power

[11] Most of the major players in the electricity industry are state owned and controlled. Therefore it is not surprising that a large part of the ERC funding comes from state agencies.

Capacity Building

One of the fundamental drivers in setting up the ERC was to tackle the skills shortage. The ERC has had significant success in this regard with several extremely well qualified and experienced individuals graduated or due to graduate in the very near future (Appendix II & IV). However the ERC has had less success in tackling capacity within the university sector in particular academic staff numbers. Research in the electricity area is predominately an electrical engineering activity and it is tightly coupled with its sister discipline of electronic engineering. During the Information Technology (IT) boom of the late 1990s the attractiveness of electronic engineering to students was detrimental to electrical engineering. Ironically the IT collapse in early 2000, and the dramatic downturn in the industry and student numbers, has had a detrimental impact on both electronic and electrical engineering as most school leavers are unaware of the difference. This, coupled with government policy to expand in the electronic engineering area in the late 1990s has led to a dramatic oversupply of academics and places in electronic engineering and an undersupply of academics and students in electrical engineering. With the advent of SFI and its significant research funding, in Information and Communications Technology, some academic vacancies in electronic engineering are still being filled as research-led universities take the view that the students numbers will return in the medium term and the posts can be justified largely on research opportunities. No similar research funding has been available for electrical engineering. The consequence is that over the past 17 years University College Dublin has made no new appointments in Electrical Engineering and this is the single biggest challenge facing the ERC in the future. In order to address this challenge Professor O'Malley has consciously reduced his involvement in other research activities in particular his interests in Biomedical Engineering. Also the ERC has sought strategic partners in particular the Queen's University Belfast, the University of Washington Economic and the Economic and Social Research Institute, (details in Appendix III). These actions can only have limited impact and the ERC intends to meet this challenge by building its own capacity. The next five year funding cycle of the ERC (2006 – 2011) will specifically address this issue and we will be seeking support from the electricity industry, educational sector and from any initiative which arise from this consultation.

Capacity building will only occur if there is significant long term commitment to research funding. As funding will be necessarily limited, it is important that the money is allocated on a competitive basis to ensure that the best institutions are confident of sustained support for their research activities and that funding will not be used to support sub competitive proposals. Electrical engineering is a niche area and there is a need for only one or two research active groups in the country. These successful research groups will be motivated to attract undergraduate students and the whole system from undergraduate to post-graduate to post-doctoral education can start to evolve in support of the energy sector on the island of Ireland. This process will take five to ten years to achieve if we are to rely on home grown talent but could be faster if we are successful in attracting in talent from outside Ireland.

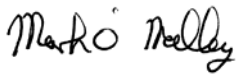
Research funding must be competitive and designed to build a small number of research entities in the energy field in the Republic of Ireland. The funds should be targeted at key disciplines and at PhD students in particular. All Ireland PhD

programmes are being mooted at this time within the academic community as a way of addressing the capacity issue and energy research could potentially form an all Ireland (or indeed an all island) PhD programme.

Conclusion

If clarification of any points raised by this response is required, the ERC would be happy to provide further details. We look forward to a positive outcome to this process.

Yours sincerely,



Professor Mark J O'Malley, PhD
Director Electricity Research Centre
http://ee.ucd.ie/erc/
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Appendix I: Short Curriculum Vitae Mark O'Malley

Personal data

Date of Birth	20 July 1962
Work Address	Dept. of Electronic and Electrical Eng., University College Dublin, D4, Ireland.
Contact details	Email: mark.omalley@ucd.ie Tel +353 1 716 1851

Education

1983	B.E. Electrical Engineering, National University of Ireland.
1987	Ph.D. Electrical Engineering, National University of Ireland.

Scholarships and distinctions

2002	IEEE, UKRI, Power Engineering Society Outstanding Engineer Award
1999	Fulbright Fellowship, one year sabbatical University of Washington, USA
1999	University College Dublin, President Research Fellowship
1994	Fulbright Fellowship, six month sabbatical University of Virginia, USA

Fellowships/memberships of professional bodies

2001	Fellow of Institution of Engineers of Ireland (FIEI)
2001	Fellow of Institution of Electrical Engineers (FIEE)
1996	Senior Member of Institute of Electrical and Electronic Engineers (SMIEEE)
1990	Chartered Engineer (CEng)

Employment Record

1999 -	Associate Professor, University College Dublin, Ireland
1996 – 1999	Statutory Lecturer, University College Dublin, Ireland
1990 – 1996	College Lecturer, University College, Dublin, Ireland
1988 – 1990	Assistant Lecturer, University College, Dublin, Ireland
1987 – 1988	Research Engineer, CAPTEC, Malahide, Co. Dublin
1986 – 1987	Temporary Assistant Lecturer, University College, Dublin, Ireland

Sabbaticals

2005 -	University of Cape Town, New South Wales & Washington (3 months)
1999 – 2000	University of Washington, Seattle, USA (1 Year)
1997 -	University of Cape Town (1 Month)
1994 – 1995	University of Virginia, USA (6 Months)

Recent Professional activities

2003 – present	Chairman, IEEE, United Kingdom and Republic of Ireland, Power Engineering Society Chapter.
2005	Member International Steering Committee of the international conference on Future Power Systems, Amsterdam, November, 16-18, 2005.
2004	Chairman of Technical Working Group & Member Renewable Energy Development Group, Department of Marine Communications and Natural Resources
2004	Joint Chairman of IEE, IEEE, Colloquium on Efficient Electricity Markets, Dublin, March, 2004
2003 –present	Reviewer IEEE Transactions Power Systems, IEEE Transactions on Power Delivery, IEE Proceedings Generation Transmission and Distribution,
2002 – 2003	Chairman of Institution of Electrical Engineers (IEE) Irish Committee
2003	Chairman of IEE, IEEE, CIGRE Colloquium on the technical challenges of increasing wind energy penetration in electricity networks, Dublin, March, 2003
2003	Editor, special issue in Wind Engineering on "Technical challenges of increasing wind energy penetration in electricity networks"

RESEARCH INTERESTS: Control engineering, modeling and optimization with applications to Electrical Power Systems and Biomedical Engineering.

STUDENTS SUPERVISED: 8 PhDs and 10 Masters to completion, three Post Docs, seven PhDs and one Masters currently being supervised.

FUNDING: €2,330,000 as principal investigator, €966,000 as co principal investigator.

PUBLICATIONS: 55 Journal Papers (24 in the IEEE Transactions which are internationally recognised as the highest impact research journals in electrical and electronic engineering), 5 book chapters, 59 conference papers, 3 reports and 18 workshop and miscellaneous contributions.

Selected Publications

Lalor, G., Ritchie, J., Flynn, D. and O'Malley, M.J., "The Impact of Combined Cycle Gas Turbine Short Term Dynamics on Frequency Control", *IEEE Transactions on Power Systems*", in press, 2005.

Keane, A and M.J. O'Malley, M.J., "Optimal Allocation of Embedded Generation on Distribution Networks", *IEEE Transactions on Power Systems*", in press, 2005.

Doherty, R., Lalor, G. and O'Malley,M.J., "Frequency Control in Competitive Electricity Market Dispatch", *IEEE Transactions on Power Systems*", in press, 2005.

Mullane, A. and O'Malley, M.J., "The inertial-response of induction-machine based wind-turbines", *IEEE Transactions on Power Systems*, in press, 2005.

Doherty, R. and O'Malley, M.J., "New approach to quantify reserve demand in systems with significant installed wind capacity", *IEEE Transactions on Power Systems*", pp. 587 -595, 2005.

Beck, R., Houtman, C., O'Malley, M.J., Lowery, M. and Stegeman, D.F., "A Technique to Track Individual Motor Unit Action Potentials in Surface EMG by Monitoring Their Conduction Velocities and Amplitudes", *IEEE Transactions on Biomedical Engineering*, Vol. 52, pp. 622 – 629, 2005.

Lowery, M., and O'Malley, M.J., "Analysis and simulation of changes in EMG amplitude during high level fatiguing contractions", *IEEE Transactions on Biomedical Engineering*, Vol. 50, pp. 1052 – 1062, 2003.

De Chazal, P., Heneghan, C., Sheridan, E., Reilly, R., Nolan, P. and O'Malley, M. J., "Automatic processing of single lead electrocardiogram for the detection of obstructive sleep apnea", *IEEE Transactions on Biomedical Engineering*, Vol. 50, pp. 157 – 165, 2003.

Flynn, M., Sheridan, P., Dillon, J. and O'Malley, M. J., "Reliability and reserve in competitive electricity market scheduling", *IEEE Transactions on Power Systems*, Vol. 16, pp. 78 – 87, 2001.

Flynn, M., Walsh, M. and O'Malley, M. J., "Efficient use of generator resources in emerging electricity markets", *IEEE Transactions on Power Systems*, Vol. 15, pp. 241 – 249, 2000.

Lowery, M., Vaughan, C. L., Nolan, P. and O'Malley, M. J., "Spectral compression of the electromyographic signal due to decreasing muscle fibre conduction velocity", *IEEE Transactions on Rehabilitation Engineering*, Vol. 8, pp. 353 – 361, 2000.

Reilly, R. and O'Malley, M. J., "Adaptive gesture based device for augmentative communication", *IEEE Transactions on Rehabilitation Engineering*, Vol. 7, pp. 174 – 183, 1999.

O'Sullivan, J. and O'Malley, M. J., "A new methodology for the provision of reserve in an isolated power system", *IEEE Transactions on Power Systems*, Vol. 14, pp. 519 – 524, 1999.

Walsh, M. and O'Malley, M. J., "Augmented Hopfield network for constrained generator scheduling", *IEEE Transactions on Power Systems*, Vol. 14, pp. 765 – 771, 1999.

Flynn, M. and O'Malley, M. J., "A drum boiler model for long term power system dynamic simulation", *IEEE Transactions on Power Systems*, Vol. 14, pp. 209 – 217, 1999.

Walsh, M., Flynn, M. and O'Malley, M. J., "Augmented Hopfield network for mixed integer programming", *IEEE Transactions on Neural Networks*, Vol. 10, pp. 456-458, 1998.

Dorgan, S., and O'Malley, M. J., "A mathematical model for skeletal muscle activated by N-Let pulse trains", *IEEE Transactions on Rehabilitation Engineering*, Vol. 6, pp. 286-299, 1998.

Walsh, M. and O'Malley, M. J., "Augmented Hopfield network for unit commitment and economic dispatch", *IEEE Transactions on Power Systems*, Vol. 12, pp. 1765 - 1775, 1997. Also presented at the IEEE Power Engineering Society, Summer Meeting, Berlin, July 1997.

O'Malley, M. J., Abel, M. F., Damiano, D. and Vaughan, C. L., "Fuzzy clustering of children with cerebral palsy based on temporal-distance gait parameters", *IEEE Transactions on Rehabilitation Engineering*, Vol. 5, pp. 300 - 309, 1997.

Dorgan, S. and O'Malley, M. J., "A nonlinear mathematical model of electrically stimulated muscle", *IEEE Transactions on Rehabilitation Engineering*, Vol. 5, pp. 179 - 194, 1997.

O'Sullivan, J. and O'Malley, M. J. "Economic dispatch of a small utility with a frequency based reserve policy", *IEEE Transactions on Power Systems*, Vol. 11, pp. 1648 - 1653, 1996.

O'Sullivan, J. and O'Malley, M. J., "Identification and validation of dynamic global load model parameters for use in power system simulation", *IEEE Transactions on Power Systems*, Vol. 11, pp. 851 - 857, 1996.

Appendix II: ERC Research Team

Director, Professor Mark O'Malley

	Topic	Time Period
Visitors		
Dr. Brendan Fox	Sabbatical leave from the Queen's University Belfast, two days a week.	Jan 05 – June 05
Postdocs		
Dr. Alan Mullane	Modelling wind turbine generators	2004 – 2005
Dr. Morgan Bazilian	Renewable energy policy (part time)	2002 – 2006
Dr. Hugh Mullany	Electrical demand side management in the Republic of Ireland (part time)	2003 - 2005
PhD Students		
Ms. Gill Lalor	Frequency control in an island power system with increasing wind penetration and combined cycle gas turbines	2001 – 2005
Mr. Ronan Doherty	Operation of power systems with increasing amounts of wind generation & optimal plant mix	2001 – 2005
Ms. Eleanor Denny	Emissions reduction with renewable generation on electric power & economics of embedded generation	2003 – 2007
Mr. Andrew Keane	Optimal development of electrical distribution systems with increasing deployment of embedded generation.	2003 – 2007
Mr. Garth Bryans	Impact of tidal stream energy devices on electric power systems. (with Dr. B. Fox, Prof. Peter Crossley and Prof. T Wittaker, Queen's University Belfast)	2003 – 2007
Ms. Julia Ritchie	Frequency Events on the Irish Electricity Network (Queen's University Belfast Student partially funded by the ERC and supervised by Dr. Damian Flynn)	2003 – 2005
MEngSc Students		
Mr. Kevin Leask	Effective Reactive Power Compensation of Transmission Networks (part time, Kevin is a full time Employee of ESB National Grid)	2005 – 2007
Administrator		
Ms. Rosemary Logue	Part time administration of the Electricity Research Centre	2001 – 2006

Appendix III: ERC Collaborations

1994 – present	Dr. B. Fox & Dr. Damian Flynn	The Queen's University Belfast, Northern Ireland
1999 – present	Prof. C. C. Liu	University of Washington, Seattle, USA
2004 – present	Prof. John Fitzgerald	The Economic and Social Research Institute, Ireland.
2004 – present	Prof. H. Outhred	University of New South Wales, Australia
2004 – present	Dr. Lawrence Jones	AREVA T&D, Bellevue, Washington, USA

Appendix IV: ERC[12] Research Outputs (1996 – 2005)

Theses Completed

Mr. Tim Hurley	Wind resource assessment	MEngSc 2004
Mr. Shane Rourke	Locational marginal pricing of electricity	MEngSc 2003
Ms. Meadhbh Flynn	Generator resources and the scheduling problem	PhD 1999
Mr. Paul Sheridan	Reliability and scheduling in competitive electricity markets	MEngSc 1999
Mr. Joseph Dillon	Scheduling of a hydrothermal power system	MEngSc 1998
Mr. Michael Walsh	A novel neural network for power system scheduling	PhD 1998
Mr. Jonathan O'Sullivan	Modelling and identification of emergency reserve with applications to isolated power systems	PhD 1996
Mr. Fintan Slye	An expert system for the restoration of an island power system	MEngSc 1993

Publications

International refereed journal papers

Lalor, G., Ritchie, J., Flynn, D. and O'Malley, M.J., "The Impact of Combined Cycle Gas Turbine Short Term Dynamics on Frequency Control", *IEEE Transactions on Power Systems*", in press, 2005.

Keane, A and M.J. O'Malley, M.J., "Optimal Allocation of Embedded Generation on Distribution Networks", *IEEE Transactions on Power Systems*", in press, 2005.

Doherty, R., Lalor, G. and O'Malley,M.J., "Frequency Control in Competitive Electricity Market Dispatch", *IEEE Transactions on Power Systems*", in press, 2005.

Mullane, A. and O'Malley, M.J., "The inertial-response of induction-machine based wind-turbines", *IEEE Transactions on Power Systems*, in press, 2005.

Lei, Y., Mullane, A and Lightbody,G., "Modelling of the wind turbines with a doubly fed induction generator for grid integration studies" *IEEE Transactions on Energy Conversion*, in press, 2005.

Doherty, R. and O'Malley, M.J., "New approach to quantify reserve demand in systems with significant installed wind capacity", *IEEE Transactions on Power Systems*", pp. 587 -595, 2005.

Bazilian, M., Denny, E. and O'Malley, M.J., "Challenges of Increased Wind Energy Penetration in Ireland", *Wind Engineering*, vol. 28, pp. 43-56, 2004.

Doherty, R, Bryans, L., Gardner, P., O'Malley, M.J., "Wind penetration studies on the Island of Ireland", *Wind Engineering*, vol. 28, pp. 27-42, 2004.

Dillon, J. and O'Malley, M. J., "Augmented Hopfield network with augmented Lagrange multipliers for mixed integer programming", *Neurocomputing,* 42, pp 323-330, 2002.

Dillon, J., Walsh, M. and O'Malley, M. J., "Novel initialisation of the augmented Hopfield network for improved generator scheduling", *IEE Proceedings Generation, Transmission and Distribution,* Vol. 149, pp. 593 – 599, 2002.

Flynn, M., Sheridan, P., Dillon, J. and O'Malley, M. J., "Reliability and reserve in competitive electricity market scheduling", *IEEE Transactions on Power Systems*, Vol. 16, pp. 78 – 87, 2001.

Flynn, M., Walsh, M. and O'Malley, M. J., "Efficient use of generator resources in emerging electricity markets", *IEEE Transactions on Power Systems*, Vol. 15, pp. 241 – 249, 2000.

O'Sullivan, J. and O'Malley, M. J., "A new methodology for the provision of reserve in an isolated power system", *IEEE Transactions on Power Systems*, Vol. 14, pp. 519 – 524, 1999. Also presented at the IEEE Power Engineering Society, Summer Meeting, San Diego, July 1998.

Walsh, M. and O'Malley, M. J., "Augmented Hopfield network for constrained generator scheduling", *IEEE Transactions on Power Systems*, Vol. 14, pp. 765 – 771, 1999. Also presented at the IEEE Power Engineering Society, Summer Meeting, San Diego, July, 1998.

[12] Research outputs include those of the Power Systems Research group at University College Dublin as it predates the ERC.

Flynn, M. and O'Malley, M. J., "A drum boiler model for long term power system dynamic simulation", *IEEE Transactions on Power Systems*, Vol. 14, pp. 209 – 217, 1999. Also presented at the IEEE Power Engineering Society, Summer Meeting, San Diego, July 1998.

Walsh, M., Flynn, M. and O'Malley, M. J., "Augmented Hopfield network for mixed integer programming", *IEEE Transactions on Neural Networks*, Vol. 10, pp. 456-458, 1998.

Walsh, M. and O'Malley, M. J., "Augmented Hopfield network for unit commitment and economic dispatch", *IEEE Transactions on Power Systems*, Vol. 12, pp. 1765 - 1775, 1997. Also presented at the IEEE Power Engineering Society, Summer Meeting, Berlin, July 1997.

O'Sullivan, J. and O'Malley, M. J. "Economic dispatch of a small utility with a frequency based reserve policy", *IEEE Transactions on Power Systems*, Vol. 11, pp. 1648 - 1653, 1996. Also presented at the IEEE Power Engineering Society, Winter Meeting, Baltimore, MD, USA, January 1996.

O'Sullivan, J. and O'Malley, M. J., "Identification and validation of dynamic global load model parameters for use in power system simulation", *IEEE Transactions on Power Systems*, Vol. 11, pp. 851 - 857, 1996. Also presented at the IEEE Power Engineering Society, Summer Meeting, Portland, Oregon, USA, July 1995.

Book chapters

O'Malley, M. J. and Liu, C. -C. "Competitive wholesale electricity markets", *in Power System Restructuring and Deregulation: Trading, Performance, and Information Technology*, Editor. L. L. Lai, Wiley, pp. 76 – 109, 2001.

Walsh, M. P and O'Malley, M. J., "Artificial neural networks for generator scheduling", *in Modern Optimisation Techniques in Power Systems*, Editor Y. H. Song, Kluwer, pp. 113 - 137, 1999.

International refereed letters, comments and editorials, in journals

O'Malley, M. J., "Guest Editorial", *Wind Engineering*, vol. 28, 2004.

O'Malley, M. J., "Discussion of an adaptable automated procedure for short term electricity load forecasting" *IEEE Transactions on Power Systems*, Vol. 12, p. 94, 1997.

O'Sullivan, J. and O'Malley, M. J., "Discussion of Non linear Dynamic Load Modelling: Model and Parameter Estimation", *IEEE Transactions on Power Systems*, Vol. 11, p. 1695, 1996.

O'Sullivan, J. and O'Malley, M. J., "Discussion of Neural Networks for predicting the operation of an under-frequency load shedding system", *IEEE Transactions on Power Systems*, Vol. 11, p. 1357, 1996.

International refereed conference papers

Denny, E and O'Malley, M. J., "Impact of increasing levels of wind generation in electricity markets on emissions reduction", 7th IAEE European Energy Conference - European Energy Markets in Transition, Bergen, Norway, Aug, 2005.

Keane, A. and O'Malley, M.J., "Impact of wind generation on emissions under alternative power system operation approaches", University Power Engineering Conference, Cork, Sept, 2005.

Denny, E. and O'Malley, M.J., "Impact of distributed network constraints on distributed generation capacity", University Power Engineering Conference, Cork, Sept, 2005.

Keane, A. and O'Malley, M.J., "Optimal allocation of embedded generation on the Irish distribution network", CIRED, Turin, June, 2005.

Bryans, G., Fox, B., Crossley, P., T J T Whittaker and O'Malley, M.J., "Tidal stream resource and impact assessment for Ireland", International Conference on Advanced Power System Automation and Protection, Korea, Juju Island, Korea, 2004.

Tande, J. O, Muljadi, E., Carlson, E., Pierik, J., Estanqueiro, A., Sørensen, P., O'Malley, M.J., Mullane, A., Anaya-Lara, O., Lemstrom, B., "Dynamic models of wind farms for power system studies –status by IEA Wind R&D Annex 21, European Wind Energy Conference, London Nov 2004.

Doherty, L. S, C. O'Connor, M. O'Malley, W.T. McNicholas and P.J. Nolan, "Optimising the Measurement of Genioglossus Fatigue Using Surface Electromyography," 100th International Conference of the American Thoracic Society, Florida, USA May 21-26, 2004. p. A434.

Lalor, G., Ritchie, J., Rourke, S., Flynn, D. O'Malley, M.J., "Dynamic Frequency Control with Increasing Wind Generation", *IEEE PES General Meeting*, Denver 2004.

Doherty, R., Denny, E. and O'Malley, M.J., "System operation with a significant wind power penetration", *IEEE PES General Meeting*, Denver 2004.

Rourke, S, O'Malley, M. J., Miyakawa, K., and Liu, C.-C., "Strategic Bidding in an Optimal Power Flow Electricity Market", *IEEE Power Tech*, Bologna, Italy, June, 2003.

Lalor, G. and O'Malley, M., "Frequency Control on an Island Power System with Increasing Proportions of Combined Cycle Gas Turbines", *IEEE Power Tech*, Bologna, Italy, June, 2003.

Doherty, R. and O'Malley, M., "Quantifying Reserve Demands due to Increasing Wind Power Penetration", *IEEE Power Tech*, Bologna, Italy, June, 2003.

Sheridan, P. Flynn, M., and O'Malley, M. J., "Generator scheduling with demand bids", *Proceedings of the IEEE PES Summer Meeting*, Seattle, pp. 2109 – 2114, vol. 4, July 2000.

Flynn, M., Power, M., Browne, P. and O'Malley, M. J., "Balance between generating plant costs and system load following requirements", *Proceedings of the CIGRE Symposium on Working Plant and Systems Harder*, paper no. 400-3, London, June 1999.

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O'Sullivan, J., M., Flynn, M. and O'Malley, M. J., "Modelling of frequency control in an island power system", *Proceedings of the IEEE Power Engineering Society Winter Meeting*, pp. 574 – 579, New York, February 1999.

Dillon, J., Walsh, M. and O'Malley, M. J., "Unit commitment for a small isolated utility", *Proceedings of the 32nd University Power Engineering Conference*, pp. 871 - 874, Manchester, September 1997.

O'Sullivan, J. and O'Malley, M. J., "A study to investigate reserve constraints in economic dispatch for small utilities", *Proceedings of the 32nd University Power Engineering Conference*, pp. 383 - 386, Manchester, September 1997.

Walsh, M., Dillon, J. and O'Malley, M. J., "Augmented Hopfield network for constrained unit commitment", *Proceedings of the 32nd University Power Engineering Conference*, pp. 65 - 68, Manchester, September 1997.

Flynn, M., O'Malley, M. J. and Timoney, D., "Modelling boiler response to co-ordinate reserve in isolated power systems", *Proceedings of the IFAC/CIGRE Symposium on Control of Power Systems and Power Plants*, pp. 475 - 480, Beijing, August 1997.

Walsh, M. and O'Malley, M. J., "Unit commitment for a power system with pumped storage units", *Proceedings of the IFAC/CIGRE Symposium on Control of Power Systems and Power Plants,* pp. 586 - 591, Beijing, August 1997.

Workshop and conference presentations

Keane, A. and O'Malley, M. J., "How should renewable generation be connected to the distribution network ?", University College Dublin 150th, April, 2005.

Denny, E. and O'Malley, M. J., "Can wind power really aid emissions reduction", University College Dublin 150th, April, 2005.

O'Malley, M.J. "Research in to Grid Integration of Wind Power", British Isles Wind Technical Panel, Belfast, Nov. 18, 2004.

Mullane, A and O'Malley, M.J. "Inertial response of induction machine based wind turbines", British Isles Wind Technical Panel, Belfast, Nov. 18, 2004.

O'Malley, M.J. "System integration of wind turbines in Ireland", International Energy Agency Topical expert Meeting on System Integration of Wind Turbines, Dublin, Nov 9. 2004.

Mullane, A and O'Malley, M.J. "Inertial response of induction machine based wind turbines", International Energy Agency Annex XXI Meeting", Dublin, Nov. 8, 2004.

O'Malley, M.J. "Grid integration of wind power in Ireland, Lessons Learnt and Tidal Stream Energy in Ireland, International Energy Agency Workshop on Grid Integration, Ocean Energy Systems, Copenhagen, Nov 4, 2004.

O'Malley, M.J., "Irish Wind Industry, Technical Challenges and Opportunities", Irish Wind Energy Association, Arklow, October 2004.

O'Malley, M. J. and Lalor, G "Ancillary Services Markets and Wind Power", 3rd Workshop, EPSRC BLOWING Network, Manchester, May 2002.

Published reports

ILEX Energy, UCD, QUB and UMIST, "Operating reserve requirements as wind power penetration increases in the Irish electricity system", Sustainable Energy Ireland, http://www.sei.ie/uploads/documents/upload/publications/Ilex-Wind-Reser_rev2FSFinal.pdf, 2004.

ILEX Energy, UMIST and UCD, "The price and dispatch impact of a centralised wholesale electricity market in Ireland", Commission for Energy Regulation, www.cer.ie/cerdocs/cer03100.pdf, 2003.

Jansens *et al.*, CIGRE Task Force 38 – 02 14, "Large frequency disturbances: analysis and modelling needs" CIGRE Final Report, November 1998.

In review

Lalor, G., Mullane, A., and O'Malley, M.J., "Frequency Control and Wind Turbine Technologies", *IEEE Transactions on Power Systems*", in review, 2005.

Denny, E., and O'Malley, M.J., "Wind Generation, Power System Operation and Emissions Reduction" *IEEE Transactions on Power Systems*", in review, 2004.

Bryans, A.G., Fox, B., Crossley, O., O'Malley, M.J., "Impact of tidal generation on power system operation", *IEEE Transactions on Power Systems*", in review, 2005.

Appendix V: ERC Visitors, Seminars & Colloquia

Speakers	Topic	Partners	Date
Half day event, multiple speakers	UCD Energy Research Centre and ESRI Energy Policy Research Centre Seminar	ESRI	May 25th 2005
Prof. Mohammad Shahidehpour	Impact of electricity markets on electric power systems	IEEE, IEE, SEI,	May 17th 2005
Prof. Goran Strbac	Benefits and costs of active management of distribution networks	IEE, IEEE, SEI, UCD	Nov 16th 2004
Half day event, multiple speakers	UCD Energy Research Centre and ESRI Energy Policy Research Centre Seminar	ESRI	Nov 3rd 2004
Prof. Chen Ching Liu	Security of Supply Issues: Technical and Economic Aspects.	IEE, IEEE, SEI	July 29th 2004
Half day event, multiple speakers	ERC research seminar		March 23rd 2004
All day event, multiple speakers	Efficient electricity markets, lessons for Ireland	IEE, IEEE, SEI	March 4th 2004
Dr. Prabha Kundur	Sustainable Electric Power Systems in the 21st Century: Requirements, Challenges and the Role of New Technologies	IEE, IEEE, SEI	October 21st 2003
One day event, multiple speakers	Colloquium on technical challenges of increasing wind energy penetration in electricity networks	IEE, IEEE, IEI & CIGRE	March 6th 2003
Prof. Nick Jenkins	Embedded (Dispersed, Distributed) Generation	IEE	April, 18th 2002
Half day event, multiple speakers	ERC research seminar		April 15th 2003
Half day event, multiple speakers	ERC research seminar	UCC & QUB	July 2002
Half day event, multiple speakers	ERC research seminar		March 2002
Dr. Janusz Bialek	Transmission Management and Congestion Pricing	IEE	March 5th 2001

Note
CIGRE = International Council on Large Power Systems
IEI = Institute of Engineers of Ireland
IEE = Institution of Electrical Engineers
IEEE = Institute of Electrical and Electronic Engineers
QUB = The Queen's University Belfast
SEI = Sustainable Energy Ireland
UCD = University College Dublin

APPENDIX VI: Re: Letter of Intent, Technology Platform for the Electricity Networks of the future

Department of Electronic and Electrical Engineering
Belfield, Dublin 4, Ireland

Tel: + 353 1 716 7777 Fax: + 353 1 283 0921

University College Dublin
Department of Electronic and Electrical Engineering

European Commission
Directorate-General for Research
Energy Production and Distribution Systems

30th April 2005

Dear Sir/Madam

Re: Letter of Intent, Technology Platform for the Electricity Networks of the future

This letter of intent is being prepared on behalf of most of the major stakeholders in the electricity industry on the island of Ireland (Northern Ireland and the Republic of Ireland). We are collectively seeking an opportunity to nominate a representative from the island of Ireland, who will act in a personal capacity, onto the main advisory group. The contributors to this letter are:

Transmission System Operators

- Electricity Supply Board, National Grid (ESBNG), the Transmission System Operator in the Republic of Ireland.
- System Operator Northern Ireland (SONI), the system operator in Northern Ireland.

Network operators and owners

- Electricity Supply Board, Networks (ESBN), the distribution system operator and the network owner.
- Northern Ireland Electricity, the network owner and operator in Northern Ireland.

Generators

- Electricity Supply Board, Power Generation (ESBPG) the main generator on the island of Ireland.
- Airtricity, the largest wind power generator on the island of Ireland.
- The Irish Wind Energy Association, the main association representing wind generators in the Republic of Ireland.
- Viridian Power an independent generator in the Republic of Ireland and a supplier on the island.

Small to medium size enterprises

- Cylon Controls, an energy management system company.

Energy authorities

- Sustainable Energy Ireland (SEI), the statutory authority responsible for promoting and assisting the development of sustainable energy in Ireland.

Regulators

- Northern Ireland Authority for Energy Regulation (NIAER), the energy regulator in Northern Ireland.
- The Commission for Energy Regulation (CER), the energy regulator in the republic of Ireland.

Research groups

- The Electricity Research Centre (ERC) in University College Dublin which is the leading power systems research centre in the Republic of Ireland and is funded by ESBN, ESBPG, ESBNG, CER, Airtricity, Cylon, and SEI .
- The Energy Policy Research Centre (EPRC) in the Economic, Social Research Institute (ESRI) which is the main energy policy research centre in the Republic of Ireland.
- The Electric Power and Energy Research Centre (EPERC) in the Queen's University Belfast which is the leading power systems research group in Northern Ireland and one of the leading groups in the United Kingdom.

Government departments

- The Department of Communications, Marine and Natural Resources (DCMNR) the government department responsible for energy in the Republic of Ireland.
- Department of Enterprise Trade and Employment (DETI) the government department responsible for energy matters in Northern Ireland.

In summary most of the major stakeholders in the electricity industry and all the major research capability on the island of Ireland are supporting this letter of intent.

Due to the recent rapid increase in the deployment of wind power the island of Ireland, as a single synchronous system, is perhaps approaching one of the highest wind penetration levels in the world. On the island of Ireland we are facing issues now that other systems will face in the future and we are gaining a lot of experience in this area. There are also cross-border issues driven by the desire to establish an all island energy market and to operate the two systems more closely. Our reasons for participating are as follows:

- We believe that the island of Ireland presents an interesting model of what will happen on other systems as their penetration levels rise. We believe that the system presents an excellent location for exploring the issues of integration and penetration of wind energy and other forms of embedded generation. Given its size, small but not insignificant, it is potentially a test bed for many of the future developments in Electricity Networks.
- We wish to share the practical experience and knowledge that we are gaining rapidly due to our high penetration levels.
- This is an excellent opportunity for the island of Ireland to learn from the experiences of our European colleagues.

We are proposing that one or two individuals from the above individual organisations would be invited by the Commission to join the advisory council in a personal capacity. Below is a list of potential individuals all of whom are electrical engineers who are senior individuals within their organisations with very relevant experience in electrical networks. We look forward to a positive response from the Commission and the opportunity to discuss this matter further.

- Mr. Leslie Bryans, SONI
- Dr. Paddy O'Kane, Airtricity
- Professor Mark O'Malley, Director ERC
- Mr. Paul Smith, ESB National Grid

Each of these individuals has completed an expression of interest form with their own details and these are also attached.

Yours sincerely

Professor Mark J O'Malley, PhD
Director Electricity Research Centre
http://ee.ucd.ie/erc/
email: mark.omalley@ucd.ie