

SRDG - Advancing Marine Renewable Energy Research Capacity in Scotland

Lead Institution: Heriot-Watt University

Partner HEI: UHI Millennium Institute

Duration: 4/5 years from 1st May 2007

Reporting Period: First Annual Progress Report to Steering Group.

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1. Accountability, administrative and start-up arrangements

The project kick-off meeting, of all Work Group Leaders and appropriate administrators, held on 27th April 2007 agreed a start date of 1st May 2007, principally to ensure that sufficient time was available for the recruitment of the PDRAs. Some minor changes in emphasis were agreed with respect to the 4 themes and the Work Group Leaders for these (see Section 2 below).

In addition to a major press release, advertisements for these were placed in New Scientist, the Press and Journal, other appropriate magazines, and via <jobs.ac.uk> and emailing alerting services. There were 23 applications of which 12 were UK resident workers. 10 were shortlisted for interview during 8/9 August 2007, and 3 offers were made of which 2 were subsequently taken up.

Dr Kasinatha Pandian Pitchai was offered, and has taken up the post associated with Work Group 1 (HWU/ICIT Orkney), but only finally commenced on 3rd March 2008 once visa and work permit arrangements had been finalised.

Dr Mark Shields was offered the post associated with Work Group 3 (ERI/UHI Thurso) and took up this position on 31st October 2007.

Further rounds of advertising led to the appointments of Dr Eric Grist and Dir Michael Bell to Work Groups 2 and 4 respectively.

We are delighted to be able to attract such international talent to the HEI centres, based respectively at Orkney and Thurso, but the time taken to do this and additional delays in obtaining work permits and visas for non-resident workers, has thus delayed somewhat the contribution expected from the PDRAs to the project. A number of meetings between Work Group Leaders have nonetheless made progress with the administrative and start-up arrangements, and in some areas have made considerable progress in achieving and surpassing expected outcomes during year 1 of the SRDG.

The project has been widely press released and also its aims and objectives presented to a wide range of industry and government representatives (see details below). Further promotion of the project is also occurring at All Energy (launch of the SRDG announced at All Energy in 2007) and other relevant conferences.

The preferred composition of the Steering Group has been agreed (and will be chaired by Professor Lord Wallace of Tankerness), with the first meeting of this taking place in December 2008. Other academic staff, with interests in Work Group themes (at both HWU and UHI), have also been drawn in to the project. The stakeholder workshop list of invitees is taking shape. This will be an open and inclusive forum, to which any interests will be welcome. A date for the first meeting has not yet been agreed, but is likely to be set at the first Steering Group meeting.

Core funding of £480,000 has been awarded by Highlands and Islands Enterprise and Orkney Islands Council for the broader MREDS research programme, thus providing a broader collaborative platform for the SRDG capacity building and new proposal development.

2. Details of progress against the project milestones and target outcomes set out in the proposal document

Key sectoral roadblocks to the development of marine renewables in Scotland have been identified within the MREDS research programme. Critical to these is the pivotal importance of improving knowledge and capabilities for predicting environmental impacts. With this overall aim in mind the SRDG was developed with the following objectives:

- A focus for existing expertise to collaborate through joint academic and industry networks;
- The appointment of 4 specialist post-doctoral research staff;
- Engaging with EMEC's unique resources, facilities and testing environments;
- Establishing a platform for the development of new research projects and activities;
- Cement the key linkages with industry and other environmental and public interests.

The scope of the SRDG, which fits broadly into the wider MREDS research programme agenda on ecological and environmental effects was differentiated in 6 thematic elements, four of which are focused on research capacity and two on wider dissemination and networking. The SFC funding is providing essential support for the recruitment and development of specialist research staff and the SRDG is seen as critical to building research capacity within the HEIs in this newly emerging but rapidly developing sector. A review of activities undertaken so far is provided below against each theme.

Theme 1: Coastal Physical Processes

The understanding of physical environmental processes is critical to many of the consequent thematic investigations, particularly those seeking to determine environmental and ecological changes resulting from the extraction of wave and tidal energy. This theme, led by Dr Rob Harris (HWU/ICIT) and Dr Stuart Gibb (UHI/ERI), through the Technical Working Group 1 (TWG1) is focusing on capacity building for the determination of changes to the physical hydrographical regime and methods for examining these. Progress has been made, despite delays in visa and work permit approvals for the PDRA appointment in HWU/ICIT. Other HWU staff (e.g. Dr Karl Steven

and Dr Melissa Bowen) are providing specialist support in modeling and remote sensing aspects of this theme.

Work that was already underway on a Total funded PhD studentship is identifying limitations on use and interpretation of ADCP data for the measurement of wave in strong tidal currents. Dr Rob Harris is working on an innovative method for spatial wave measurement method in strong tidal currents with support from EMEC, and has formed the basis of a further EPSRC research proposal. Dr Rob Harris has been successful with a related EPSRC proposal jointly with the Universities of Glasgow and Strathclyde, which is examining methods which may lead to better understanding of the effects of unsteady flow on marine current turbines.

Lack of data on the Pentland Firth, a major frontier of tidal resource in Scotland, has led to the development of a joint research proposal, RASCAL PF. This proposal is being led by HWU/ICIT and UHI/ERI but involves many other specialist researchers (e.g. Professor Margot Gerritsen, Stanford University, Professor Lucy Wyatt – University of Sheffield, Professor Ian Bryden – University of Edinburgh, Professor Michael Isaacson – University of British Columbia). One element being developed within this proposal seeks a better representation of the combined effects of wave and tidal currents (both spatial and temporal, at a large scale) and discussions with the University of Stanford have led to the provision of Stanford's code "SUNTANS" to the HWU/UHI team. This will bring together both HEIs with leading international experts in a major research programme for the measurement and understanding of wave and tidal dynamics in the Pentland Firth. The SUNTANS code is loaded on the HWU cluster and is being tested. The first meeting of the group collaborating on this proposal took place on 4th-5th August 2008.

Dr Kasinatha Pandian Pitchai, the PDRA appointed to support Work Group 1, commenced work on 3rd March 2008. Early discussions with him have been on necessary software to support his contribution to the research, and the possible purchase of Mike 21, and / or other modeling software, is being progressed. He has already begun work contributing to the development of the RASCAL PF proposal.

Theme 2: Hydrodynamics and Water Column Processes

This theme examines the coupling of physical processes to biological ones in the water column. Here issues of scale – spatial and temporal, stochastic variability in water column dynamics and the pelagic system, and the understanding of mechanisms for determining the metrics of change for monitoring marine renewables development, and its detectability against other perturbations e.g. climate change, North Atlantic Oscillation etc. are critical. This theme is led by Dr Stuart Gibb (UHI/ERI), with Dr Rob Harris (HWU/ICIT).

The hydrodynamics of Pentland Firth were studied at ERI by an MSc student, Lora Jane Dillon, prior to this SRDG. This work has been developed to produce 2 papers in a conference proceedings (WREC X, Glasgow, July 2008). Further research was conducted, primarily utilizing historical current profile data and examining variability in current direction and magnitude of current shears, with the assistance of 3 students on a summer placement.

Dr Eric Grist has recently been appointed to the postdoctoral researcher post for this Work Group. His research experience has centered on developing models which utilize a variety of mathematical and statistical approaches to understand key ecological-environmental coupled mechanisms. Such methodology will be utilized to evaluate the potential impacts of tidal and/or wave marine renewable energy developments offshore on local marine populations, communities and at ecosystem level. This will be achieved also by formulating an optimal decision model defined in terms of relevant objective functions to be either minimised (for example, economic or ecological cost) or maximised (for example, energy production) subject to physical constraints (for example, grid limitations, special protected areas, feasible site locations). Model outputs will act to provide a management decision tool to assist with assessment of different marine renewable development strategies that may be adopted, dependent on prevailing criteria and value judgements that are taken.

Theme 3: Pelagic and Benthic Dynamics

This theme attempts to address near field/far field couplings to the benthos and pelagic ecosystems, addressing issues such as benthic biotope models and classification, and detectability of changes in these against other perturbations e.g. climate change. This theme extends to include infra-littoral and littoral dynamics, and is examining metrics and sentinels for ground-truthing near field. This theme is led by Dr David Woolf and Dr Mark Shields joined as the PDRA for this TWG at the end of October 2007 having completed his PhD work at SAMS. Mark thus provides a key linkage within UHI to the SAMS research centre and will act in this liaison role. Mark has taken on the task of co-ordinating the first planned publication from the SRDG which will collate and draw on the experiences of all involved in summarizing the state of our knowledge of environmental and ecological impacts from marine renewable device deployment, and has established links with the researchers at ICIT and EMEC, giving a presentation on his work to the 2008 Orkney Science Festival.

Early discussions on this general theme within TWG3 and TWG4 examined the difficulties of identifying and linking physical manifestations of change of energy extraction to biologically detectable effects. Means of measurement of physical change are very expensive and an investigation of methods for simpler, cost-effective devices is the subject of a recent successful PhD proposal made to the SUPERGEN 2 (Marine Energy) consortium. Bob Behare, the PhD student, funded by the EPSRC through SUPERGEN 2, has recently started at HWU/ICIT and will work closely with Dr Mark Shields and Dr David Woolf, in addition to Professor Jon Side and Dr Rob Harris.

There are a number of links with this theme and the recently awarded EPSRC grant for Workstream 10 of SUPERGEN 2 led by Professor Side and Dr Graham Savage (Queen's University Belfast) which is attempting to provide a rational for monitoring of ecological effects of marine energy developments.

UHI has been designated as a Strategic Delivery Body (SDB) for the distribution of European Development Funding (ERDF). ERI and SAMS will be submitting a joint application to secure funding from the SDB to support a number of PhDs affiliated to the UK-wide SUPERGEN 2 Marine programme, again strengthening links between this EPSRC funded programme and the SRDG. A number of these PhDs will be supervised by participants or recent recruits from this SRDG programme (ERI and ICIT).

Potential environmental impacts are of concern to developers and governing authorities. Contact with these has led to invitations to tender for commercial work and invitations to participate in consortia seeking European FP7 funding. ERI has joined two consortia, each applying to Energy Calls within FP7.

Theme 4: Ecological Considerations and Consequences

The final research theme considers the coupling of physical processes to broad ecological ones, and aims to address in particular the consequences of these. A number of questions of interest have arisen: whether for example the creation of Marine Protected Areas would be compatible from the deployment of marine renewable devices, which of themselves will moderate fishing impacts on the ecosystem. The Technical Working Group is led by Professor Jonathan Side and Dr Sandy Kerr.

Discussions with ICES colleagues led to the invitation to Dr Sandy Kerr and Professor Jon Side to participate in the EU FP7 proposal MESMA. This framework proposal involves 18 European research institutes in an exhaustive research investigation of areas where a marine spatial planning framework is in place or is being developed in order to conserve structure, function and processes of the constituent marine ecosystems, with the aim of determining an optimal combination of economic use, ecologic development and conservation of nature and historic values. Our contribution will be specifically on areas that are managed for marine renewables development, their compatibility with MPA (marine protected area) objectives, and on the consequences, and socio-economic effects on the fishing and other sectors. The EU FP7 MESMA proposal was submitted at the end of February and is progressing to the contract negotiation stage.

There are important synergies with an existing research project funded by the Total Foundation which is using passive acoustic techniques to monitor diving seabirds in areas where tidal turbines may be deployed. Discussions with the RSPB have looked at recent changes in diving seabird populations, and how to ensure that these changes were they to occur in the future are better understood and not inadvertently attributed to marine renewable development. Professor Side contributed to the RSPB's major event in the September 2007 Orkney Science Festival which tried to identify and discuss reasons for changes in these.

Dr Michael Bell has recently been appointed as PDRA for this Work Group and will commence work in January 2009.

Theme 5: International Networking and Dissemination (Management Team)

This TWG, led by Professor Side, is designed with the aim of ensuring networking with key research groups, nationally and internationally, especially ICES. Dissemination envisaged includes outputs to industrial, and academic audiences (including journal / conference papers). In particular the Annual Stakeholder Advisory Workshop will provide a key opportunity to engage more widely.

Total E&P Aberdeen hosted the MREDS Launch held on 6th November 2007 and this provided a unique opportunity for further discussion with industry on the SRDG. The event was chaired by Professor Lord Wallace with support from Neil Kermode at EMEC

and representatives from Highlands and Islands Enterprise and Orkney Islands Council. Follow-up meetings, which have included dissemination of the SRDG, have now been held with Scottish Power, Marathon, Talisman, Shell, ITF Energy, ITI Energy and further meetings have taken place with Scottish Power, Conoco and Marathon. Extensive discussions have taken place with Scotrenewables (tidal device developer) and AWS Power Ltd (wave device developer), and other MEC developers. Discussions on the SRDG have taken place with the RSPB, SNH, SEPA and other government, and non-governmental organisations.

Representatives from the SRDG met with the Minister of State for Energy, Malcolm Wicks MP, on 13th September 2007 to discuss a range of matters relevant to the development of the Scottish marine renewables sector. Richard Lochhead MSP, Scottish Cabinet Minister for Rural Affairs and the Environment, visited HWU/ICIT on Wednesday August 29th 2007 and received a briefing on MREDS, the SRDG and other research activities. A further briefing was given to Mike Russell (Scottish Cabinet Minister for the Environment) on 10th September 2008.

Presentations have been made to Nicol Stephen MSP (while Deputy First Minister), John Thurso MP, Rob Gibson (MSP) and Jim Mathers MSP (Minister for Enterprise, Energy and Tourism) during visits to the ERI in Thurso.

Information on the SRDG programme was also sent as part of a package of information on marine energy developments in the North of Scotland to Clarence House on the request of HRH The Prince Charles, Duke of Rothesay.

UHI/ERI provided a presentation to Research Hebrides, an organisation aiming to develop research capacity in key socio-economic sectors in the Western Isles. Brian Wilson former UK Energy Minister and Professor Sinclair Gair of Strathclyde University are members of this group.

Presentations which included the SRDG were given to the Basque Parliamentary Group in January 2008 – this delegation to Orkney included representatives from the Basque Energy Board, Industrial Development Agency, the Parliament and industry department officials.

Brief exchanges have taken place with Dr Christina Olivares of the Spanish Wave Energy Centre (WavEC) with agreement to exchange information on research in the SRDG and related studies being undertaken at WavEC.

Discussions and meetings with the Canadian Development Group planning a \$12 million demonstration tidal turbine development in the Bay of Fundy included several exchanges of common concern and interest regarding environmental impacts and issues. Contacts for the SRDG will be maintained with this group through one of their scientific advisors, Dr Gordon Fader, who has recently retired from the Bedford Institute of Oceanography (BIO).

A presentation on the SRDG was made to John Mason, Director Environmental Quality, Climate Change and Water Industry for the Scottish Government in August and to Xu Qingjun, First Secretary (Economic&Commercial) Chinese Embassy in the UK, which has led to research contacts in China which are being followed up.

SRDG members participated in the September 2008 workshop on Environmental Standards hosted by EMEC.

Dissemination and representation of the SRDG to core groups is seen as particularly important at this stage and Professor Side has given a presentation to ERP JRI Energy Advisory Board, to representatives of Scottish Development International (SDI), and participates in regular meetings with HIE, OIC and the Orkney Renewable Energy Forum, as well as the HIE/OIC/EMEC Marine Renewables Sector – Forward Planning meetings. An annual review presentation for MREDS which included the SRDG was given to OIC Councilors and senior officials from HIE.

Discussions with Shetland Islands Council and the Shetland LEC may lead to further links being established with SIC and the North Atlantic Marine College (formerly Fisheries College) in Scalloway. Discussions are also underway to investigate the possibility of a theme session at a forthcoming ICES Annual Science Conference and an appropriate ICES Working Group or Study Group to which the outputs from the SRDG can be relayed, and as noted engagement with ICES contacts led to inclusion of HWU in the FP7 MESMA proposal.

Theme 6: Raising Public Awareness (Management Team)

This theme led by Dr Sandy Kerr seeks to make a general contribution to raising public awareness and specific contributions to specialist magazines (e.g. Fishing News, BirdWatch) and Science Festivals etc. The Annual Stakeholder Advisory Workshop is also an opportunity to engage directly with the public, and special interest groups.

The project has been widely press released and has received good coverage in Scotland from local press, radio and the Press and Journal. Presentations have also been made to visiting journalists (e.g. Le Monde in September 2007), and early discussions with the organizers of the Orkney Science Festival aim to put in place some educational events linked to the SRDG for the September 2009 Festival. An article on the SRDG outlining the vision, partnership etc of the programme was published in the ERI's own newsletter (ERI Elements). This is circulated widely in the local community and sent to collaborators, local businesses, funders, stakeholders etc.

The SRDG has been fortunate in being able to provide facilities for a visiting scholar with specialist expertise in web design and interests in marine renewables. The web site is fully operational and is being populated internally with material; a newsletter is nearing completion and will promote the project and web materials to developers and other interested groups. Members of the SRDG research team hosted a workshop for the Supergen II Doctoral Training Programme – a multinational group of PhD students supported by the EPSRC Supergen programme – on environmental impacts of marine energy development, at ICIT in May 2008.

The All Energy Conference provided a major focus for the launch of the SRDG in 2007, and both HWU/ICIT and UHI/ERI presented a high profile of the developing SRDG research capacity at All Energy 2008, with staff and research students from both institutions attending.

The first Steering Group meeting will be on 5th December 2008, which will include concomitant meetings of and presentations from the Work Groups. As noted in the introduction, all 4 of the PDRAs have now been appointed. Discussions with the respective administrators of the 2 institutions are ongoing and a formal collaborative agreement has been signed. Meetings of the Management Group take place periodically and usually coincide with staff visits between ERI and ICIT.

3. Any significant variation in the expected direction of the project or change in timescale

There is no change in direction, but delays in recruitment of PDRAs are having knock on effects on projects timescales. These should ease considerably in the coming months. The delayed PDRA start dates means that we are expecting a small shift in salary costs and time scales but do not envisage these impacting the overall budget.

4. Summary against key year 1 milestones

The technical working groups are established with a wider membership participating in these and frequent exchanges between the staff involved. The Steering Group membership has been agreed and the candidate members' willingness to participate has been received. The first meeting will be on 5th December 2008. A number of the staff involved in workstreams and the appointment of Dr Mark Shields have consolidated links with SAMS, and the wider participation of HWU staff in the SRDG and through the RASCAL project proposal is established.

The four postdoctoral researchers are in now post.

5. Presentations and Publications

M.A Shields, A.T. Ford and D.K. Woolf. 2008. Ecological considerations for tidal energy development in Scotland. Full Proceedings of World Renewable Energy Congress X, Paper M22.

L.J. Dillon and D.K. Woolf. 2008. GIS Mapping of Currents and Constraining Factors for a Major Tidal Stream Resource; The Pentland Firth, Scotland. Full Proceedings of World Renewable Energy Congress X, Paper M24.

L.J. Dillon and D.K. Woolf. 2008. An Initial Evaluation of Potential Tidal Stream Development Sites in Pentland Firth, Scotland. Full Proceedings of World Renewable Energy Congress X, Paper M23.

M. A Shields, P. K. Pandian, J. C.Side, S. Gibb, R.E. Harris, S. A. Kerr and D. K. Woolf, 2008, "A Multidisciplinary Approach to Advancing Marine Renewable Energy Research in Scotland", poster presented in the International Conference on Ocean Energy, ICOE 2008, Brest, France during 15 - 17 October 2008.

P.Kasinatha Pandian, Osalusi Emmanuel, J.P.Ruscoe, J.C.Side, R.E.Harris, S.A.Kerr and C.R.Bullen, 2008, "An overview of coastal and marine measurement technologies with a particular reference to waves and currents", *International Journal of Oceans and Oceanography* (Communicated in August 2008).

Osalusi Emmanuel, Kasinatha Pandian, John Ruscoe, Robert Harris and Jonathan Side, 2009, "Analysis of Wave and Current Data at the Marine Energy Converters Site", 2009, International Conference on Ocean Engineering 2009 to be held at Indian Institute of Technology, Chennai, India during 1 – 5, Feb 2009 (accepted for oral presentation).

Osalusi E, Side J, and Harris R (in preparation). Reynolds stress and turbulence estimates in the bottom boundary layer of Fall of Warness (for journal submission).