Application for Consent to conduct
Marine Scientific Research

Date: 17th September 2015

1. General Information

1.1 Cruise name and/or number:
Novel foundation technology for renewable energy Marine Institute's survey code: CV15024

1.2 Sponsoring Institution(s):	
Name:	Science Foundation Ireland
Address:	Wilton Park House Wilton Place Dublin 2 Ireland
Name of Director:	Fiona Blighe
Name:	Marine Institute
Address:	Rinville, Oranmore, Co. Galway. Ireland
Name of Director:	Aodhan Fitzgerald

1.3 Scientist in charge of the Project:	
Name:	Kenneth Gavin
Country:	Ireland
Affiliation:	Senior Lecturer, University College Dublin
Address:	School of Civil Engineering University College Dublin Newstead, Block B Belfield Dublin 4 Ireland
Telephone:	+353 (0)1 716 3222
Fax:	
Email:	kenneth.gavin@ucd.ie
Website (for CV and photo):	http://www.ucd.ie/eacollege/csee/staffmembers/kengavin/staff,98213,en.html

1.4 Entity(ies)/Participant(s) from coastal State involved in the planning of the project:	
Name:	Vinayagamoothy Sivakumar
Affiliation:	Reader
Address:	School of Planning, Architecture and Civil Engineering Queen's University Belfast David Keir Building 39 Stranmillis Road Belfast BT9 5AG United Kingdom
Telephone:	+44 (0)28 9097 4009
Fax:	
Email:	comms.office@qub.ac.uk
Website (for CV and photo):	http://pure.qub.ac.uk/portal/en/persons/vinayagamoothy-sivakumar(e6fa1b7a-419e-4e81-b79e-

	2cc957ee1d0b).html

2. Description of Project

2.1 Nature and objectives of the project:

The Wing-Anchor project is a collaborative trans-Atlantic academic research project, involving partners in Ireland, the United States and the UK. The focus of the project is to develop a novel anchoring system that optimises the use of potential anchor energy to mobilise maximum pull-out capacity with the use of the minimum marine spread, thereby ensuring the most efficient anchor geometry. The academic group includes the Geotechnical Research Group at University College Dublin under the supervision of Dr. Kenneth Gavin; The University of Texas at Austin under the leadership of Prof. Bob Gilbert ; Rhode Island University under Prof. Aaron Bradshaw and Queens University of Belfast where Dr. Vinayagamoothy Sivakumar is leading the research team. The field anchor trials that are the subject of this proposal will be conducted by the research group at University College Dublin.

The research intends to improve and build upon a fundamental understanding of soil-structure interactions to develop a novel and efficient foundation concept: a Wing Anchor. The proposed anchor is a plate formed in the shape of a wing airplane that is installed by dropping from above the sea floor with its nose facing down (similar to a torpedo anchor). It penetrates near vertically into the seabed under its own weight. Once the anchor reaches its maximum penetration, it can be loaded using the mooring line attached to the shank. This results in opening of the shank and pitching of the anchor. As the load increases the wing dives deeper into the seabed until the full bearing capacity is mobilized (similar to a plate anchor). The installation concept of the Wing anchor is depicted in Figure 1. In this way the Wing Anchor is a self-improving foundation that utilizes natural loads to mobilize its full capacity. The proposed anchor design combines the best attributes of torpedo piles and plate anchors to reduce the anchor weight and increase the energy efficiency during installation.

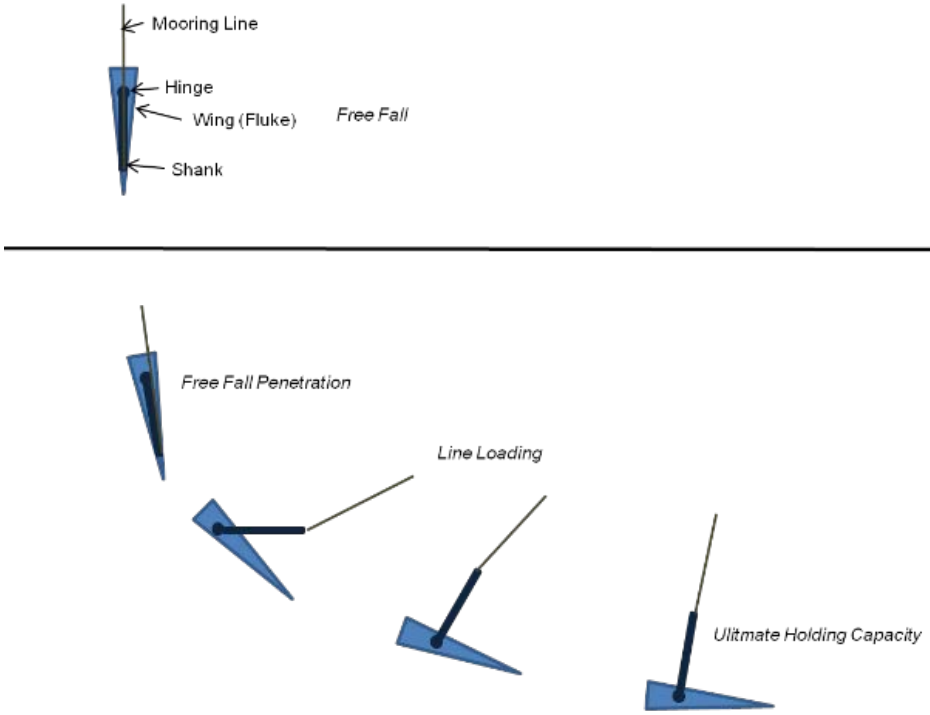


Figure 1. Flying Wing Anchor installation concept

2.2 If designated as part of a larger scale project, then provide the name of the project and the Organisation responsible for coordinating the project:
The proposed field trials are part of a larger orchestrated effort involving laboratory testing on the model scale anchor, soil element testing on the sediment samples, and numerical modelling performed by the research groups at University College Dublin and the project partners. the work is being performed by all partner institutions with funding from Science Foundation Ireland, the US National Science Foundation and the UK Government (See http://www.sfi.ie/funding/funding-calls/open-calls/us-ireland-rd-partnership-programme.html)

2.3 Relevant previous or future research projects:
The proposed offshore trials are the first large set of scale tests to be conducted on the Wing Anchor concept. However, preliminary model scale tests at University of Texas at Austin have demonstrated the promise of this novel anchor technology. One set of tests showed that the trajectory will follow that of a typical drag anchor even though the wing is initially at a steep pitch and/or moderately offset from the plane of the line (up to 30°) because the applied moments cause it to rotate before sliding. A second set of tests showed that a freely-hinged shank will provide similar behavior as that of a conventional Vertically Loaded anchor (VLA). However, where a VLA requires the shank to be fixed at a shallower angle during initial drag (set) and then opened mechanically before loading in service, the flying wing anchor requires no setting and mechanically opening of the shank, as this occurs directly in response to the applied loading

2.4 Previous publications relating to the project:
A number of papers have been submitted to journals on aspects of the laboratory tests and numerical modelling.

3. Geographical Areas

3.1 Indicate geographical areas in which the project is to be conducted (with reference in Latitude and longitude in decimal degrees, including coordinates of cruise/track/way points/sampling stations). Please provide coordinates in a separate excel spreadsheet.
The proposed anchor trials are to be conducted in a relatively sheltered area in the Firth of Clyde where past surveys (trials of torpedo anchors by Prof. Conleth O'Loughlin of the University of Western Australia) have been performed in an identified area of soft ground. The already well-characterized seabed sediment (Cone Penetration tests and lab tesing has been performed) in the proposed testing site is largely composed of soft mud (approximately 80% silt and clay) that will provide an excellent comparison to the physical model tests undertaken at our partner institutions at the University of Texas at Austin and the Queen's University Belfast. Previous successful torpedo anchor trials in the area also demonstrate the satisfactory nature of the deposits in the proposed testing site. Table below shows the approximate positioning of the proposed sampling and anchor trial sites.

	Northing		Westing			Latitude	Longitude
	Degrees	Minutes	Degrees	Minutes			
Sample 1	55	46.4	4	53.2		55.7733 N	4.8867 W
Sample 2	55	46.5	4	53.2		55.7750 N	4.8867 W
Sample 3	55	46.6	4	53.2		55.7767 N	4.8867 W
Sample 4	55	46.7	4	53.2		55.7783 N	4.8867 W
Sample 5	55	46.8	4	53.2		55.7800 N	4.8867 W
Sample 6	55	46.4	4	53.3		55.7733 N	4.8883 W
Sample 7	55	46.5	4	53.3		55.7750 N	4.8883 W
Sample 8	55	46.6	4	53.3		55.7767 N	4.8883 W
Sample 9	55	46.7	4	53.3		55.7783 N	4.8883 W
Sample 10	55	46.8	4	53.3		55.7800 N	4.8883 W
Sample 11	55	46.4	4	53.4		55.7733 N	4.8900 W
Sample 12	55	46.5	4	53.4		55.7750 N	4.8900 W
Sample 13	55	46.6	4	53.4		55.7767 N	4.8900 W
Sample 14	55	46.7	4	53.4		55.7783 N	4.8900 W
Sample 15	55	46.8	4	53.4		55.7800 N	4.8900 W

3.2 Attach chart(s) at an appropriate scale (1 page, high-resolution) showing the geographical Areas of the intended work and, as far as practicable, the location and depth of sampling Stations, the tracks of survey lines, and the locations of installations and equipment.
Please see attached. The target area is shown with a red dashed line in the attached map. The extent of the target site is expressed in terms of the Latitude and the Longitude of the corner points. The approximate water depth in the area of interest is in the range 20m-40m. The proposed tracks of 100m survey lines used for deployment of the Wing Anchor are also shown in the attached map as yellow solid lines.

4. Methods and means to be used

4.1 Particulars of vessel:	
Name:	R.V. Celtic Voyager
Type/Class:	100 A1 Research Vessel, LMC
Nationality (Flag State):	Irish
Identification Number (IMO/Lloyds No.):	
Owner:	Marine Institute
Operator:	P&O Maritime Services
Overall length (meters):	31.4
Maximum draught:	4m
Displacement/Gross Tonnage:	340
Propulsion:	Wärtsilä UD25M5 (626 kW),
Cruising & maximum speed:	<= 10 knots
Call sign:	EIQN
INMARSAT number and method and capability of communication (including emergency frequencies):	GMDSS A class, E-mail. Mini M SAT C and GSM 00 353 91 423396 / 00870 763066755 00870-764687325 / 764687326
Name of Master:	Philip Baugh/Colin McBrearty
Number of Crew:	7
Number of Scientists on board:	8 max

4.2 Particulars of Aircraft: N/A	
Name:	
Make/Model:	
Nationality (flag State):	
Website for diagram & Specifications:	
Owner:	
Operator:	
Overall Length (meters):	
Propulsion:	
Cruising & Maximum speed:	
Registration No.:	
Call Sign:	
Method and capability of communication (including emergency frequencies):	
Name of Pilot:	
Number of crew:	
Number of scientists on board:	
Details of sensor packages:	
Other relevant information:	

4.3 Particulars of Autonomous Underwater Vehicle (AUV):	
Name:	
Manufacturer and make/model:	
Nationality (Flag State):	
Website for diagram & Specifications:	
Owner:	
Operator:	
Overall length (meters):	
Displacement/Gross tonnage:	
Cruising & Maximum speed:	
Range/Endurance:	
Method and capability of communication (including emergency frequencies):	
Details of sensor packages:	
Other relevant information:	

4.4 other craft in the project, including its use:

4.5 Particulars of methods, full description of scientific instruments to be used: (for fishing gear specify type and dimension) and location			
Types of samples and Measurements:	Methods to be used:	Instruments to be used:	To be carried out within 12nm (yes or no):
Vibrocores	Vibrocorer	Vibrocorer (3m)	Yes
Gravity cores	Gravity corer	Gravity corer (3m)	Yes
Sub-bottom profiles	Acoustic imaging	Pinger	Yes
Seabed images and water depth	Acoustic imaging	Multi-beam echo sounder and side scan sonar	Yes
To identify the potential obstacles to avoid in the testing site	Magnetometer	Magnetometer	Yes

4.6 Indicate nature and quantity of substances to be released into the marine environment:
The proposed Wing Anchor technology promotes the idea of green foundation for offshore renewables in that it results in minimum environmental impact during installation and assures the full recovery of the anchor after use. Conventional anchors for offshore facilities are not very efficient, essentially requiring that a load near their desired capacity be applied during installation at considerable expense and burden to the environment. In contrast, the Wing Anchor uses its own weight and natural forces to provide a load-carrying capacity, significantly reducing the time, effort, energy, and environmental impact. Recovery after use is an important consideration in the concept of the Wing Anchor. The proposed Wing Anchor design envisions two separate recovery procedures: (1) The shank is designed so that if pull-out is not possible during normal loading, a minimal resistance can be mobilised in the reverse direction to the installation trajectory in order to facilitate the anchor recovery. (2) A secondary recovery cable is fixed at the point on the anchor where it will cause minimum trajectory in order to further assure the recovery of the anchor after use in condition of damage to the main loading line.

4.7 Indicate whether drilling will be carried out. If yes, please specify:
No

4.8 Indicate whether explosives will be used. If yes, please specify type and trade name, Chemical content, depth of trade class and stowage, size, depth of detonation, frequency of Detonation, and position in latitude and longitude:
No

5. Installations and Equipment

Details of installations and equipment (including dates of laying, servicing, method and Anticipated timeframe for recover, as far as possible exact locations and depth, and Measurements):
The anchor deployment steps involve (1) hanging the anchor from the vessel at required depth form the seabed; (2) quick releasing of the anchor using a snap shackle on the deck; (3) loading of the anchor using the vessel's bollard pull; (4) retrieving of the anchor using a separate line (see Figure 2).

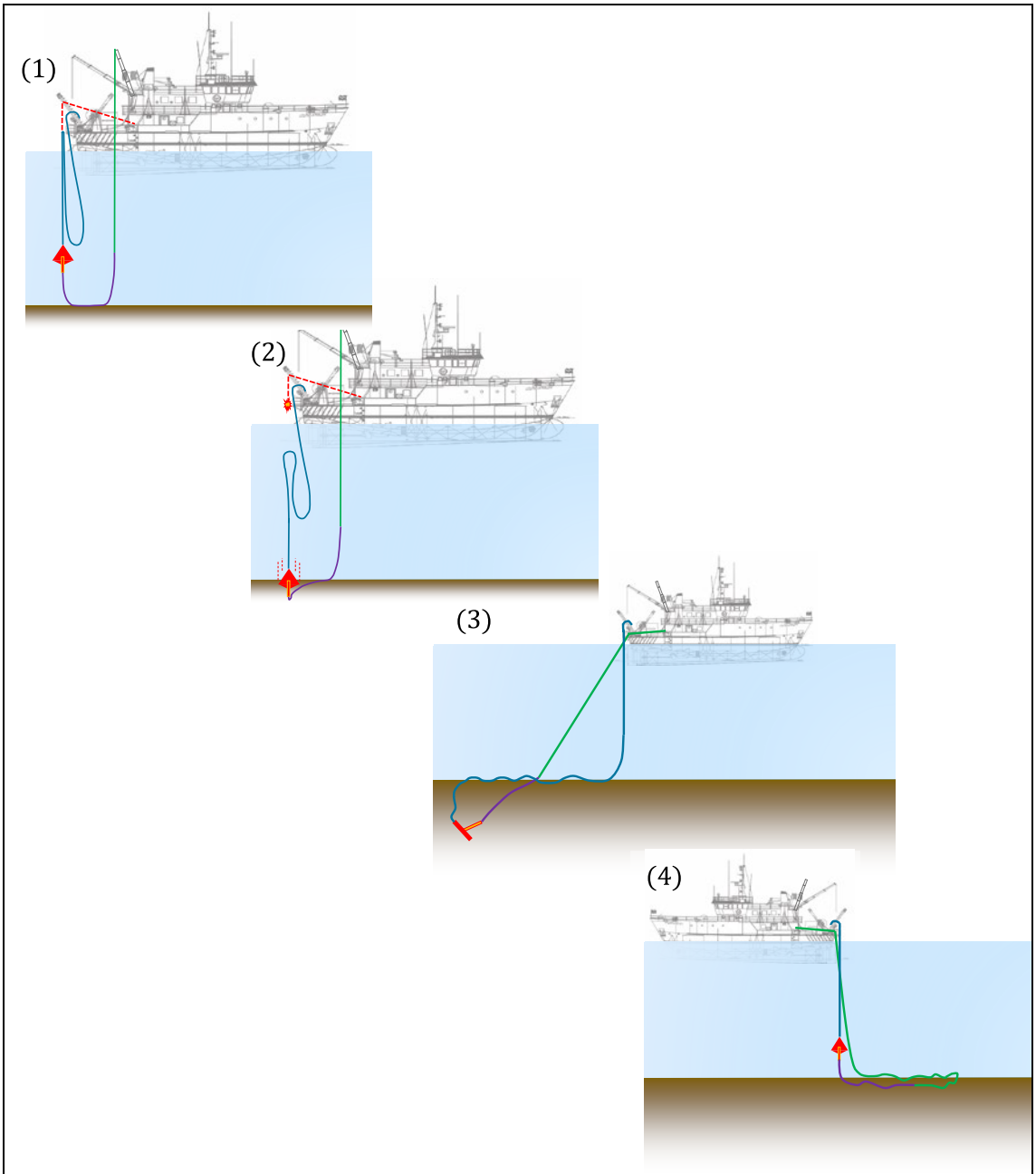


Figure 2. Installation steps

The anchor instrumentation will include a built-in gyroscope and accelerometer that will track the movements in the x,y,z plane and provide a measure of the anchor displacements, accelerations and velocities. The free-fall phase of the anchor deployment will also be monitored using a transponder that is attached to the anchor and a hull-mounted USBL. The load on the anchor will be recorded using a combination of a load cell on the deck and an underwater load shackle.

6. Dates

6.1 Expected dates of first entry into and final departure from the research area by the research vessel and/or other platforms:
Anticipated first entry: 23/11/2015 Anticipated departure: 05/12/2015

6.2 Indicate if multiple entries are expected:
The vessel may need to return to the base in Dublin in case there will be a need for repairing damaged sensors or equipment used in the field trials. Furthermore, multiple calls to local ports at night times are anticipated during the survey.

7. Port Calls

7.1 Dates and Names of intended ports of call:
Port calls to Troon and Campbeltown are envisioned on the starting date of the survey (23/11/2015) as well as calls overnight during the continuation of the survey.

7.2 Any special logistical requirements at ports of call:
There may be a need to store some of the testing equipment (vibrocorer, gravity sampler) at a dockside facility to become avail of more space on the deck during anchor trials.

7.3 Name/Address/Telephone of shipping agent (if available):

8. Participation of the representative of the coastal State

8.1 Modalities of the participation of the representative of the coastal State in the research Project:
As mentioned earlier, the Wing Anchor project is a collaborative academic research with the Queens's University Belfast as one of the project partners. The research group at Queen's University Belfast under Dr. Vinayagamoothy Sivakumar contribute to the overall project through performing model scale tests in the laboratory as well as soil element testing on the sediment samples used in these experiments. In the proposed field trials, The Queens's University Belfast, as well as other project partners, will each be represented on the deck by one PhD student who will assist with the implementation of the tests. The research team at the Queen's University Belfast will further contribute to the proposed field trials by performing soil element testing on the samples derived during the survey.

8.2 Proposed dates and ports for embarkation/disembarkation:
The embarkation/disembarkation of the research crew will in Ireland at the port of Dún Laoghaire in Ireland.

9. Access to Data, Samples and Research Results

9.1 Expected dates of submission to coastal State of preliminary report, which should include The expected dates of submission of the data and research results:
A document containing the preliminary field test factual report will be submitted to the coastal State within three months of completion of the anchor trials.

9.2 Anticipated dates of submission to the coastal State of the final report:
The final document containing the field test methodology, factual, and interpretive reports will be submitted to the coastal State within 6 months of the completions of the tests.

9.3 Proposed means for access by coastal State to data (including format) and samples:
The interpretive results from the field trials will be published in peer-reviewed journals and presentations where it will be available to the larger community of experts in the subject. The samples derived from the field trial that will not be used in the soil element testing will be stored in University College Dublin for future references.

9.4 Proposed means to provide coastal State with assessment of data, samples and Research results:

9.5 Proposed means to provide assistance in assessment or interpretation of data, samples And research results:
The research group at University College Dublin, in collaboration with its academic partners in the Wing Anchor project, will conduct a comprehensive assessment on the data acquired from the field trials. The ancho performance will be scrutinized through the on-going model scale laboratory tests and numerical modelling to arrive at a full understanding of the anchor-soil interaction. The results will then be fed to the design process of the Wing Anchor for enhanced delivery of its objectives.

9.6 Proposed means of making results internationally available:
The results from the field trials will be published in peer-reviewed journals and presentations where it will be available to the larger community of experts in the subject.

10. Other permits Submitted

10.1 Indicate other types of coastal state permits anticipated for this research (received or Pending):

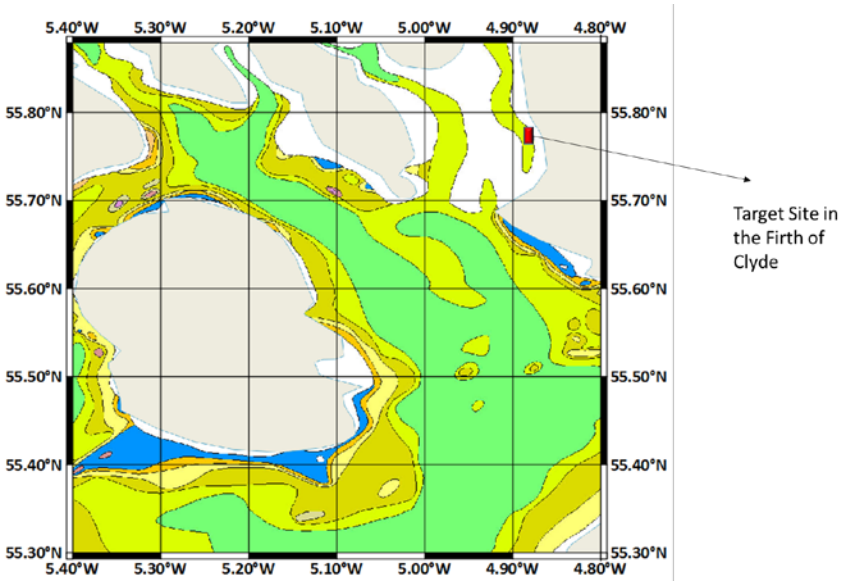
11. List of Supporting Documentation

11.1 List of attachments, such as additional forms required by the coastal State, etc.:

Signature: 

Contact information of the focal point:
Name: Kenneth Gavin
Country: Ireland
Affiliation: University College Dublin
Address: School of Civil Engineering, Newstead Building, Belfield, Dublin 4
Telephone: 01 7163222
Fax:
Email: kenneth.gavin@ucd.ie

Map of Geographical Area



Upper Extent: <**Lat:** 55 deg, 47 min, 00 sec ***N***, **Long:** 04 deg, 53 min, 30 sec ***W***>
Lower Extent: < **Lat:** 55 deg, 46 min, 00 sec ***N***, **Long:** 04 deg, 53 min, 00 sec ***W***>