

# Wave Dragon Pre-Commercial Demonstrator Project



# Structure

- Who are Wave Dragon
- Renewable Energy - Intro
- Wave Energy - Intro
- Wave Dragon Prototype Device, Denmark
- Demonstration Project
- Onshore Work
- Environmental Impact Assessment
- Construction Aspects
- Programme
- Consultations

# Wave Dragon

- Danish-based company developing a technology to convert wave energy into electricity
- One of market leaders
- Prototype machine in Danish waters, operational since May 2003
- About to move their world-wide development operations to Wales (Pembroke Dock)

# PMSS

- Consultancy company, supporting developers and construction contractors, mainly in the renewable energy sector
  - Wind, onshore and offshore
  - Tidal stream
  - Wave
  - Hydro
- Remit is to manage consultations, consents and EIA on behalf of Wave Dragon

# Renewable Energy in UK

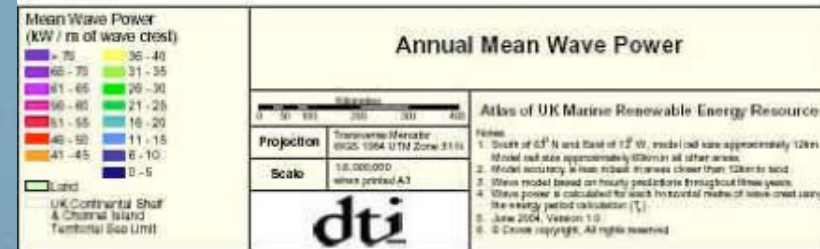
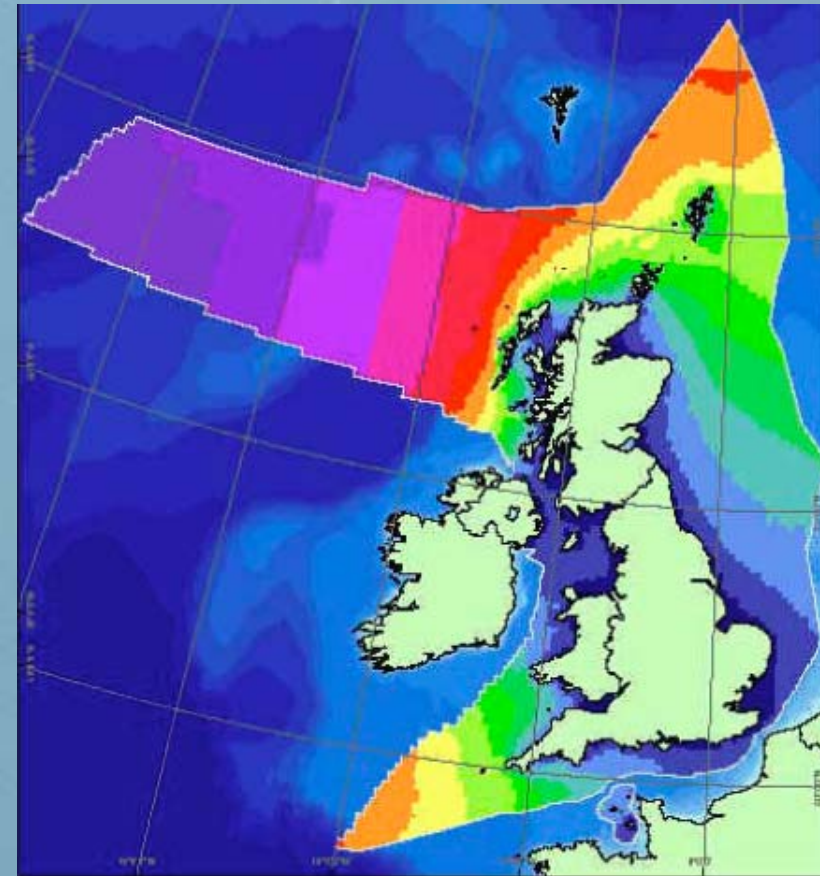
- Looming Energy Crisis
- Renewable Energy has a part to play
- Target of 10% by 2010, increased to 15% by 2015 - aspiration of 20% by 2020
- Wave and tidal energy form an integral part of the Welsh Assembly Government's (WAG) energy policy in delivering the 2020 7TWh renewable energy target, as set out in the WAG's Energy Wales Route Map

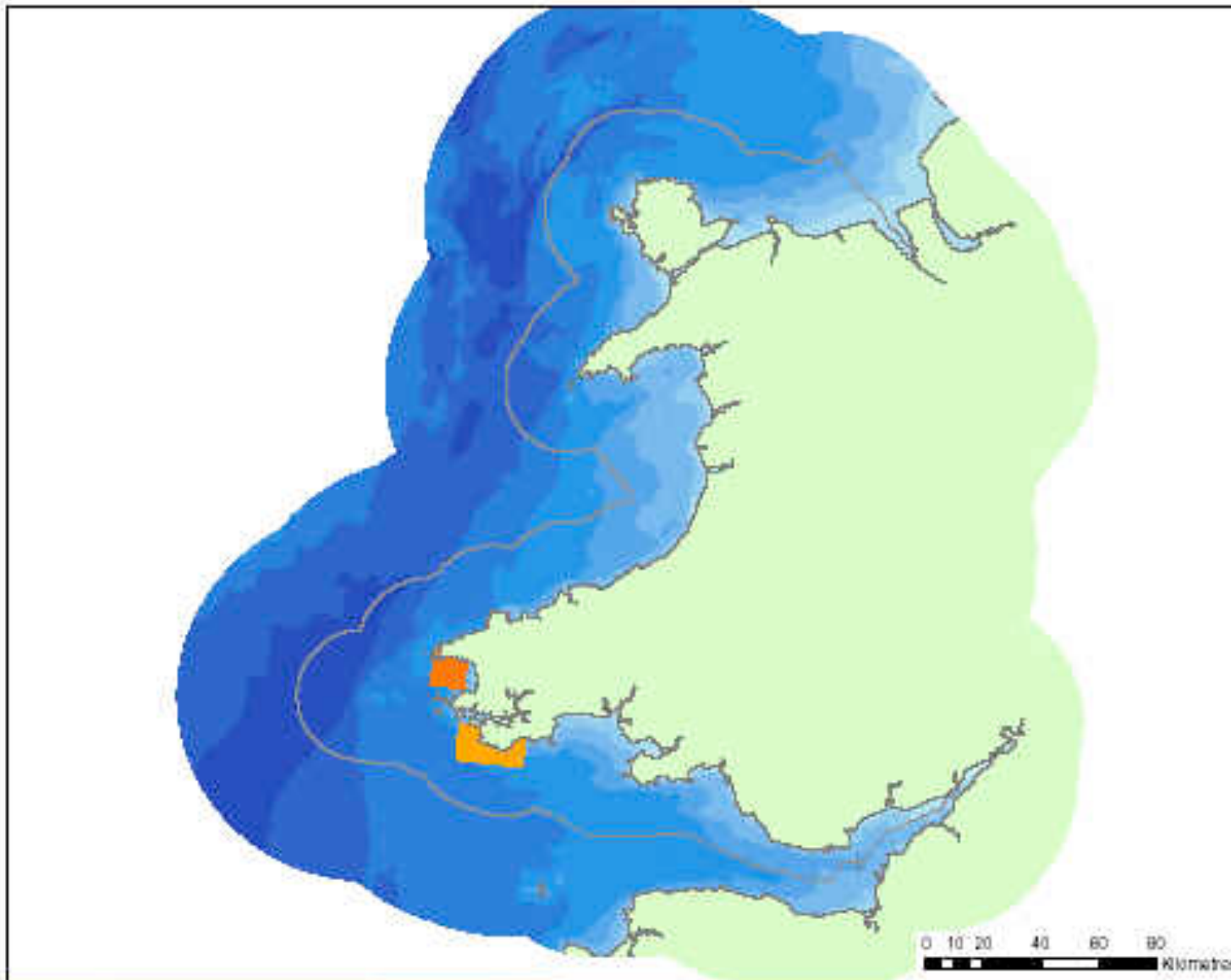
# Renewable Energy Technologies

- Wind turbines (onshore) are the most mature and cheapest
- Other technologies are further from commercial deployment :
  - Tidal stream
  - PV
  - Wave
  - Biomass
- But these technologies have a part to play in medium term, and need support to reach maturity

# Wave Energy

- UK has a large wave resource
- Resource is related to water depth





Annual Mean Wave Power	Depth (m) (MSL)
21.00 - 24.00	0 - 0
16.00 - 21.00	0 - 0
17.00 - 19.00	0 - 0
15.00 - 17.00	0 - 0
	0.0 - 10
	20.0 - 30
	40.0 - 50
	70.0 - 80
	100 - 125
	140.0 - 160
	180.0 - 190
	> 200

© Crown copyright.  
All rights reserved. 2004

Source : Atlas of UK Marine Renewable Energy Resources

Criteria =  
Wave Energy > 15 kW/m of wave crest  
Water Depth 15 - 40 m

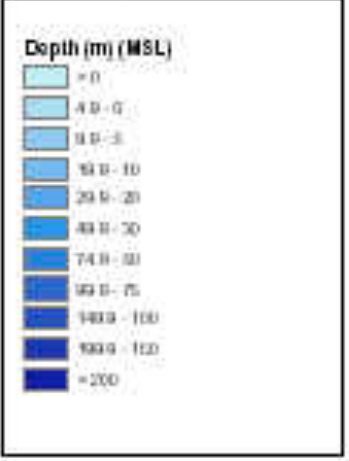
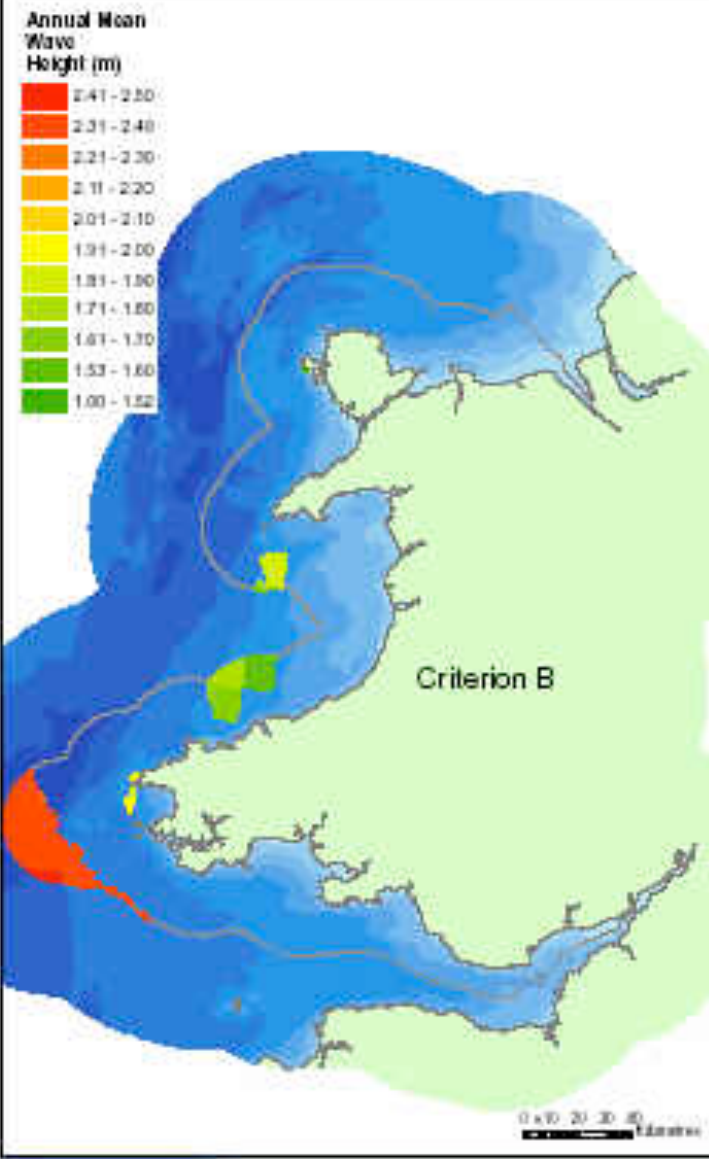
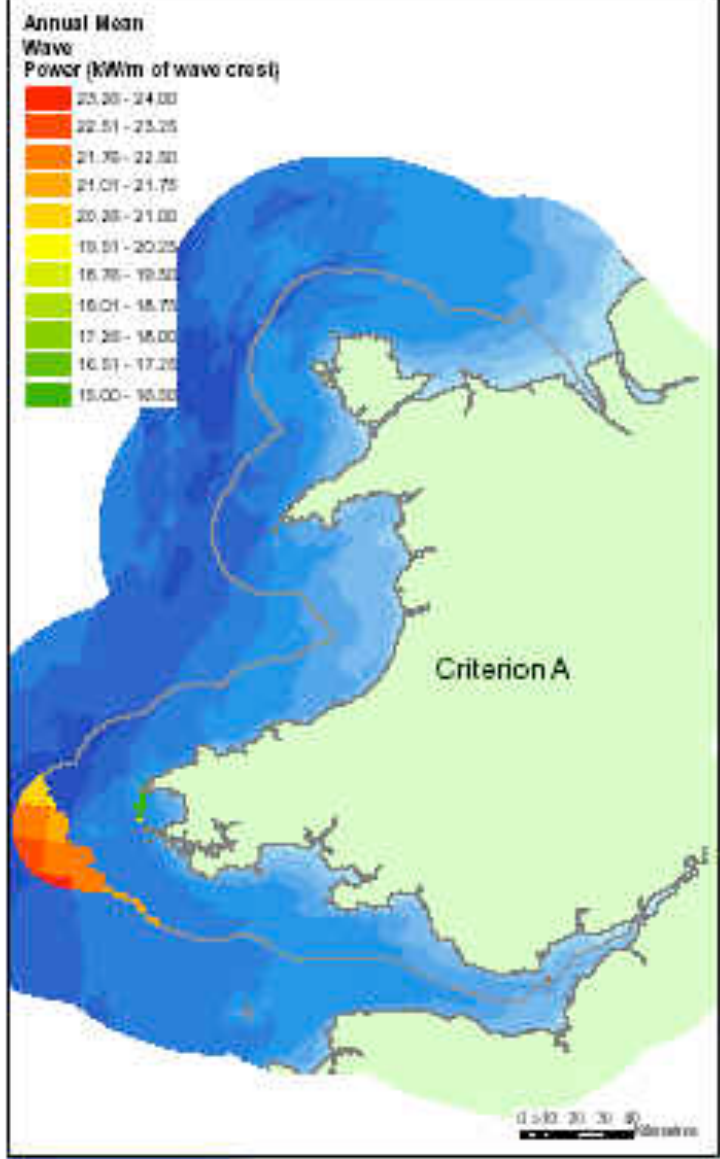
Model Cell Size = 12 km  
Scale 1:200,000

Location : R:\projects\GIS\_3471\Wave\_Nearshore\_V2.mxd



Potential Location of Nearshore Wave Devices

Figure 1



© Crown copyright  
All rights reserved, 2004  
Source: Atlas of UK Marine Renewable Energy Resources

**Criterion A**  
Wave Energy > 19KWh/m of wave crest  
Water Depth 40 - 200 m  
Tidal Current Speed < 1 m/s

**Criterion B**  
Wave Height > 1m  
Water Depth 40 - 200m  
Tidal Current Speed < 1m/s

Model Cell Size = 12 km  
Scale 1:250,000  
Location: R:\proj\atlas\34711  
Wave, deep\_water.mxd



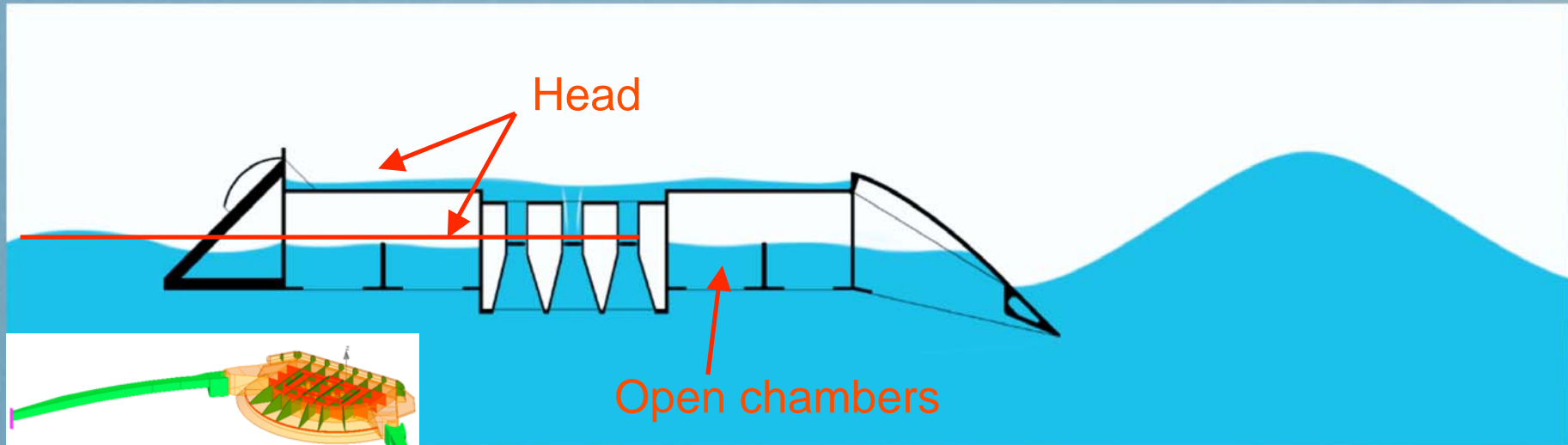
Potential Location of Offshore Wave Devices

Figure 2

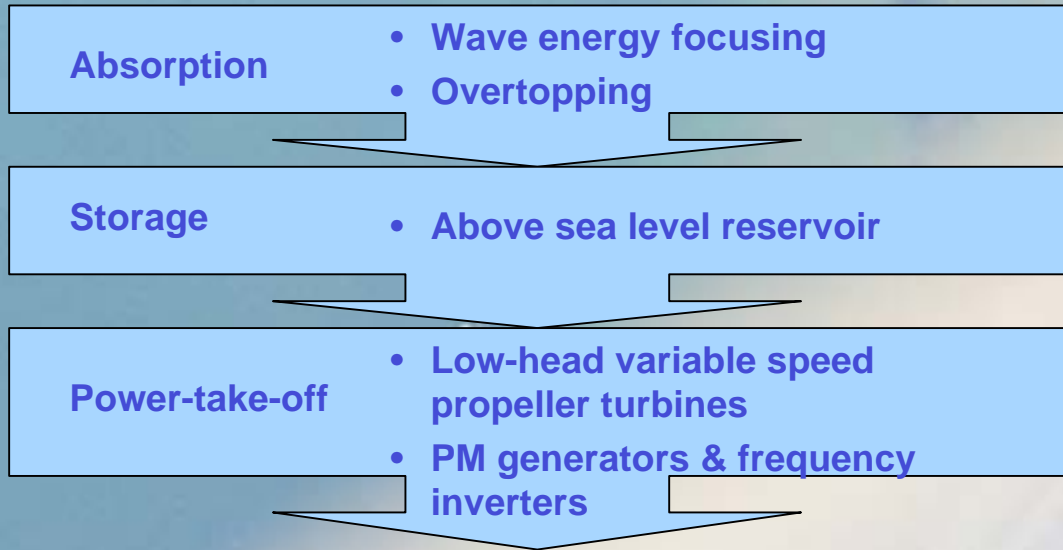
# Wave Dragon Prototype

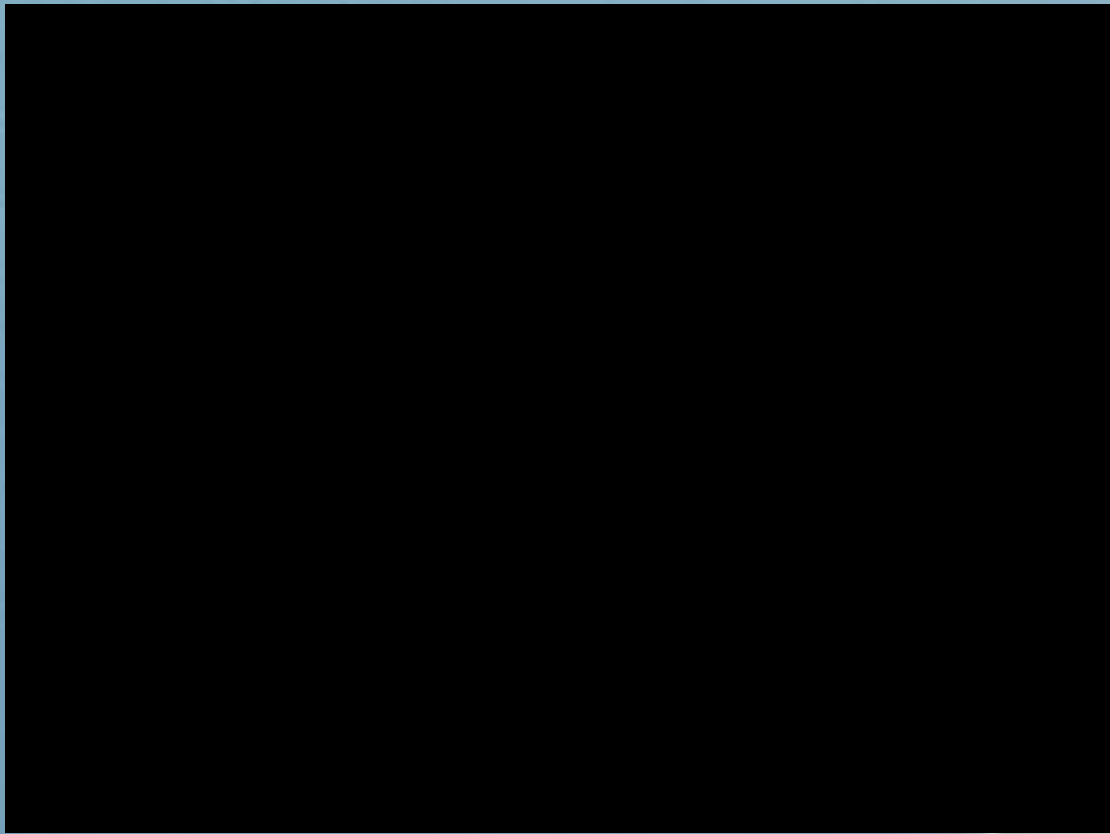
- 1 : 4.5 scale prototype, in inland Danish sea (RAMSAR site)
- In operation since May 2003
- Broke mooring in 2005 - no damage
- Redeployed April 2006



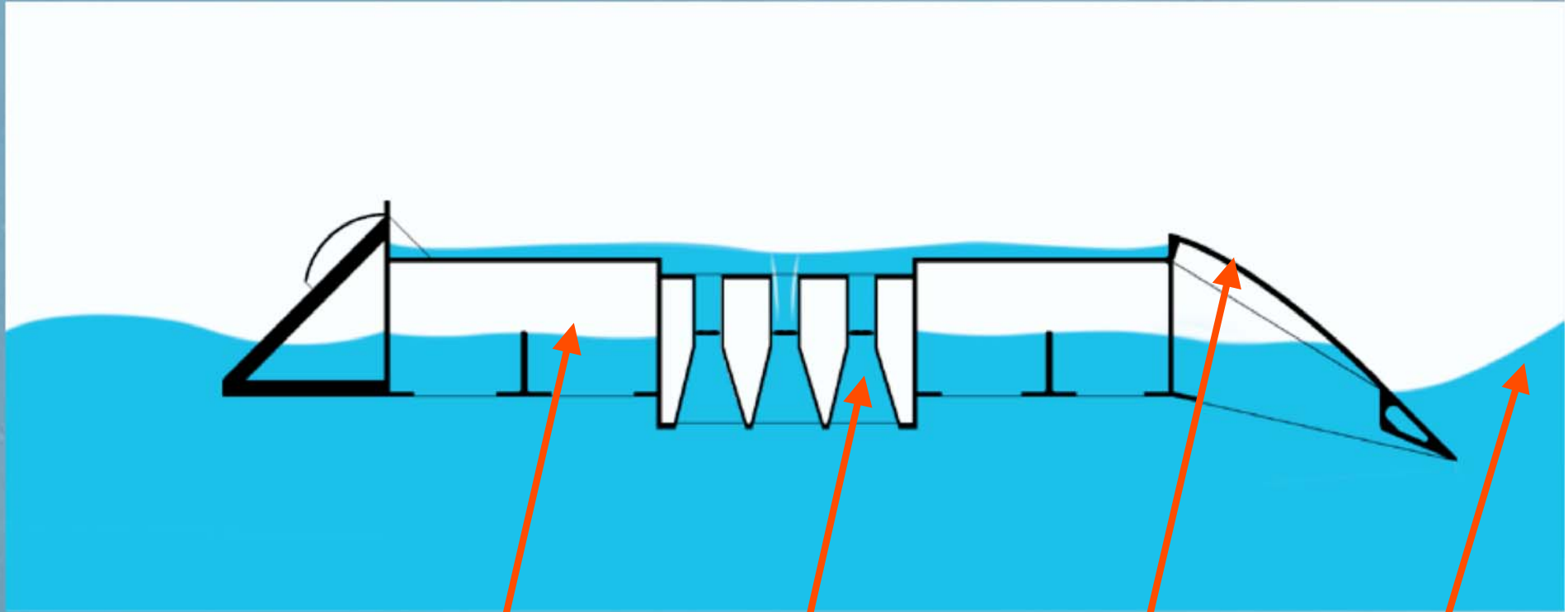


- Floating
- Adjustable floating level
- Overtopping
- Above sea level reservoir
- Hydro turbine P-T-O



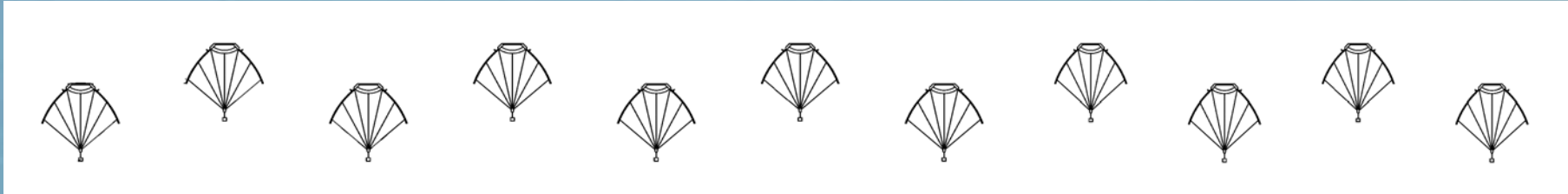


# To Be Studied: Regulation Strategy



- How much air in the chambers i.e. crest height
- How much water to take out before next wave is coming

# Wave Dragon - Power Plant Size



6.25 km

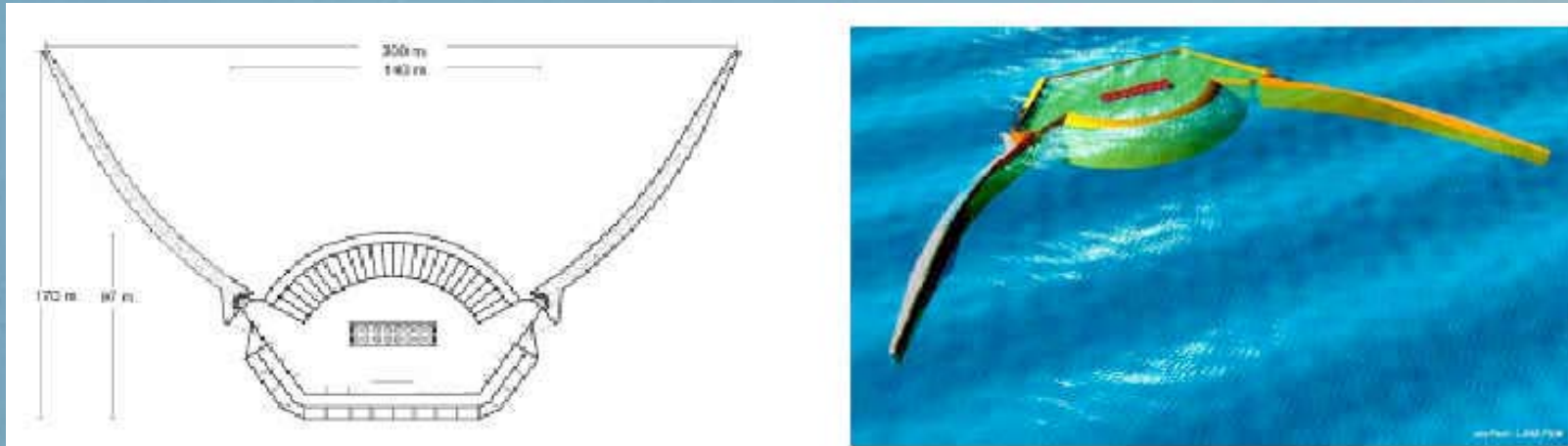
Electricity for 60,000 homes from:

- 11 units in a 6.25 km line resulting in a power plant, size: 77 MW
- A size of 5.5 km<sup>2</sup>, which is 75% of the space needed for offshore wind farms at the same power
- At deep water (more than 25 meter) almost without visual impact

# Wave Dragon Technology

- “Over-Topping” Device
- 50mm mesh across top of device - stops larger fish, birds and mammals
- Only moving parts are the enclosed turbines
- Mooring system is either a concrete gravity base or a pile secured to seabed

# Wave Dragon



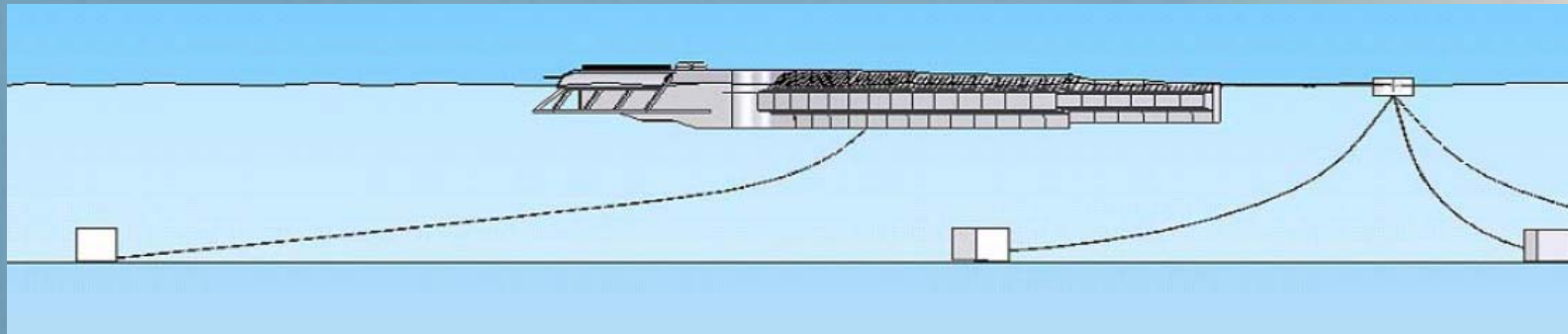
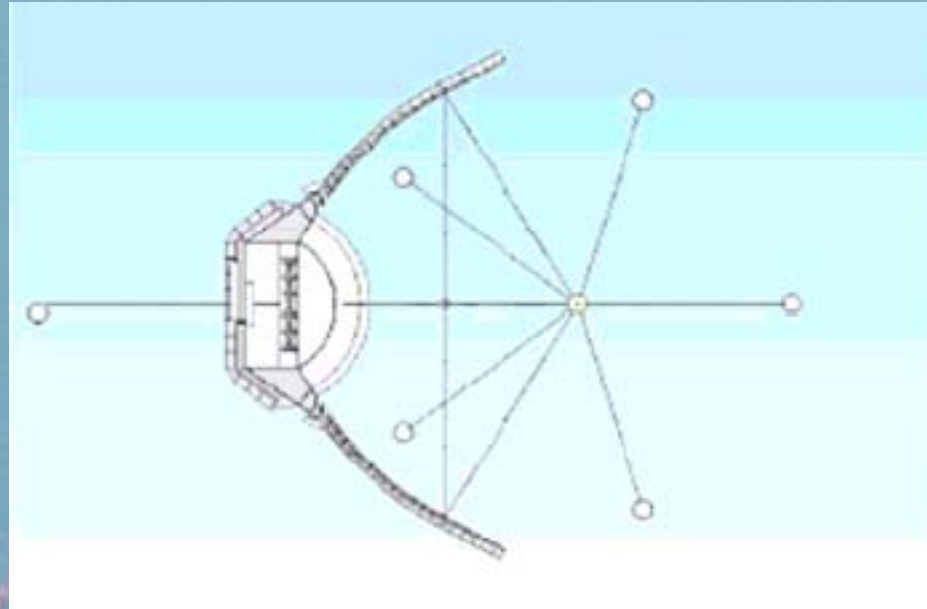
General Arrangement Drawing and Artists Impression

Distance between tips of arms	300m
Arm length	145m
Length (tip of arm to rear of central housing)	170m
Maximum height above sea level	6 – 3m
Draught	11-14m

Preliminary Dimensions

- Device is approximately the size of Thorn Island (at low tide)
- Or 1/20th the area of Skokholm

# Mooring Plan



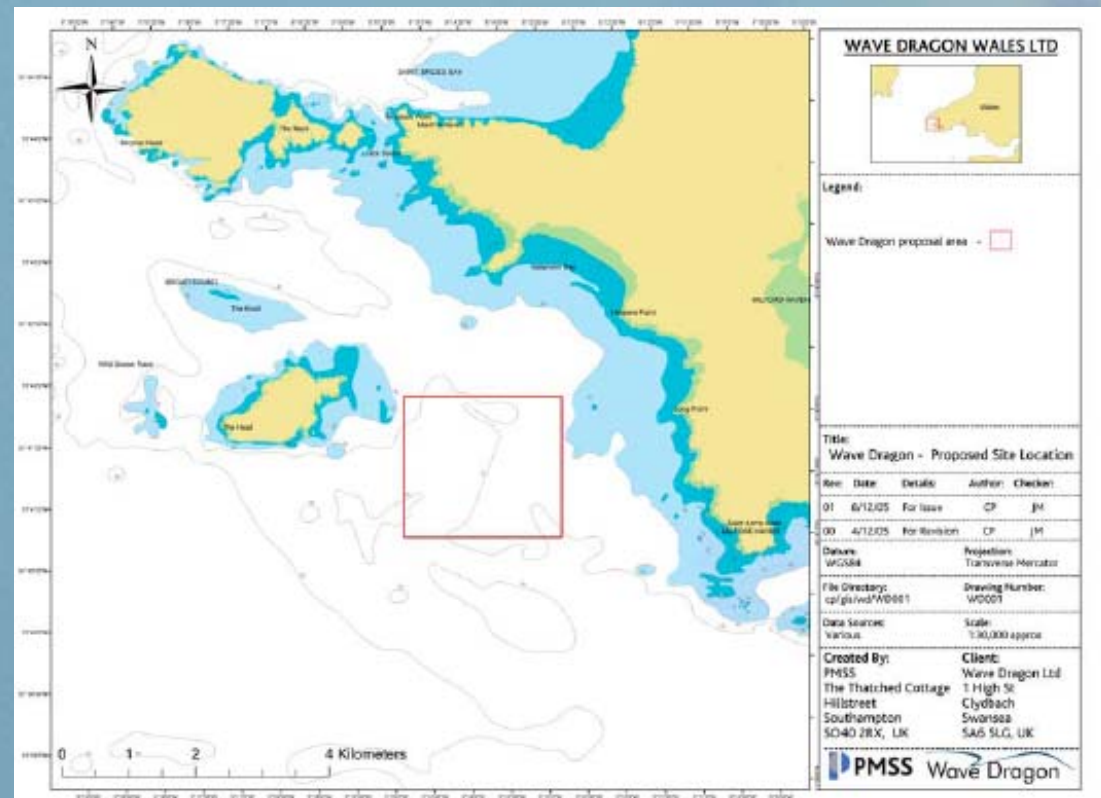
# Demonstrator Project

- Device can generate up to 7MW - export capacity is grid limited
- Proposed site is off Pembrokeshire Coast
- Funding from WAG under Objective 1
- Device in-situ for 3-5 years only
- After that, device towed to deeper water site, either off Wales or elsewhere
- Site decommissioned

# Proposed Site

1.6 km off coast at  
closest point  
Outside main  
shipping routes  
Within SAC

Box is over 30  
times larger than  
the area of the  
device



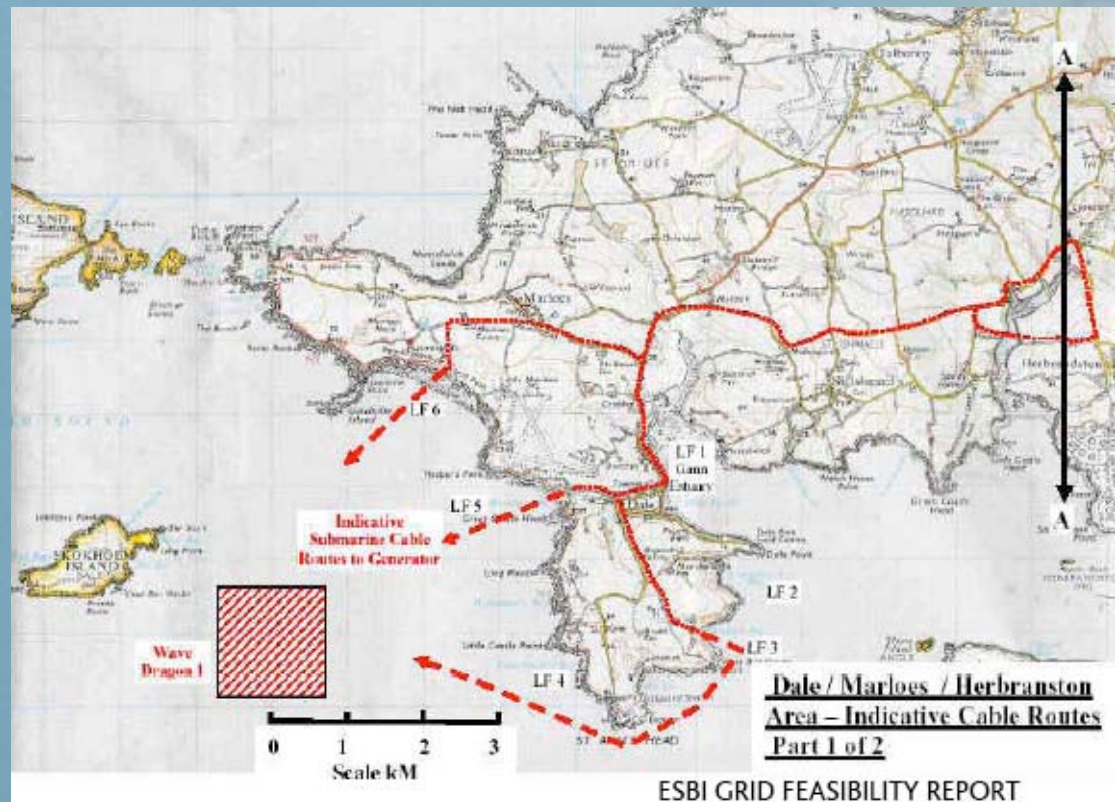
# Onshore Options

- Three Connection Options

- Steynton Sub-Station
- Total Refinery
- South of Haven

- Three Cable Landfall Options

- Marloes Sands
- Westdale Bay
- Within Haven



# Environmental Impact Assessment

- Full Environmental Impact Assessment to take place
- Scoping Report issued December 2005
- Physical Environment (geology, coastal processes, etc)
- Biological Environment (benthos, fish, mammals, birds)
- Human Environment (landscape, fisheries, navigation, archaeology, recreation, other uses, etc...)
- EIA due for completion Autumn 2006

# Ongoing Work

- EIA Scoping Report Issued
- Geophysical Survey (offshore) now complete
- Fisheries consultations initiated
- Landscape work initiated (ZVI's received)
- Navigation survey initiated January
  - **Being Repeated August**
- Benthic Survey initiated January
  - **Being Repeated August**

# Surveys Conducted

- **Landscape Survey (Enviros Ltd)**
  - Theoretical visibility mapping to predict the visual influence of the device to a radius of 15km
  - Viewpoint photography with which to produce the photomontages
- **Geophysical Survey (Osiris Ltd)**
  - 24<sup>th</sup> to 27<sup>th</sup> of January
  - Survey area mostly bare rock with a dusting of sediment
  - Data passed to CMACS Ltd for further in depth Geophys analysis and to Wessex Archaeology Ltd for in depth archaeology analysis

# Surveys (cont)

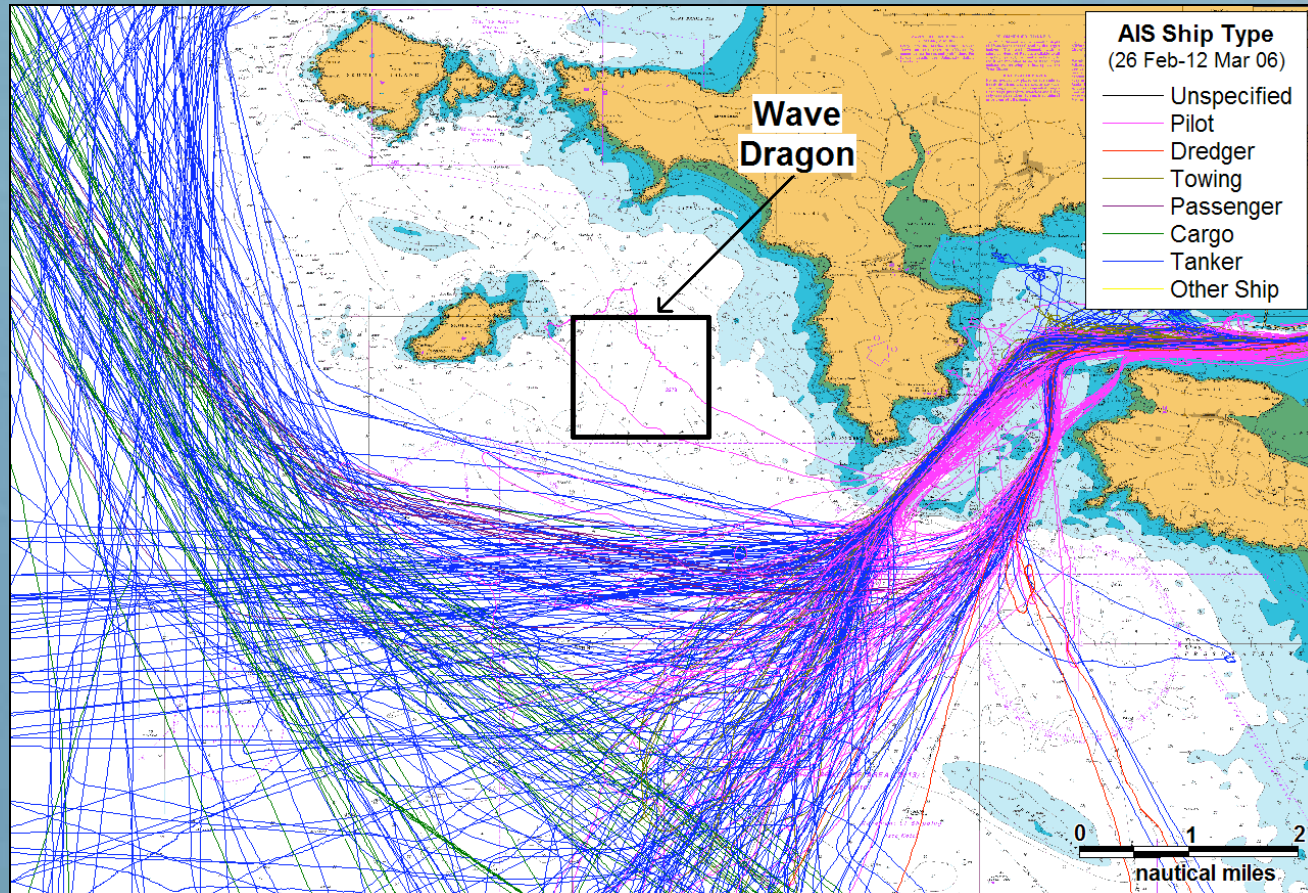
- **Benthic Survey (CMACS Ltd)**
  - Initial grabs from 27<sup>th</sup> to 30<sup>th</sup> January (suggested by Geophys)
  - Only 14 sites as very little sand in the area
  - Analysed (CCW), to design summer sampling
  - Summer sampling August
- **Navigation Survey (Anatec Ltd)**
  - 26<sup>th</sup> of February to 12<sup>th</sup> March
  - Track all vessels that pass survey area - data used for safety analysis
  - Further study conducted August for Summer figures
- **Archaeology Survey (Wessex Archaeology Ltd)**
  - Begun desk study of archaeological records from the area
  - Reviewing geophysical data for anomalies (wrecks, etc.)

# Photomontage





# Navigation (14 days)



# Outline Programme

- Environmental Impact Assessment to Summer 2006
- Submissions for Consents Summer 2006
- Potential receipt of Consents March 2007
- Start of Construction Q3 2006
- Deployment Q2 2007
- Environmental Monitoring up to 2010

# Construction Aspects

- Conventional civil and marine engineering techniques required
- Construction and servicing expected to take place from Milford Haven
- Potential opportunity for longer term “wave farms” in deeper water
- Potential to develop local infrastructure (esp. turbines)

# Consultation

- Wave Dragon is committed to thorough consultation process “from the beach backwards”
- Happy to speak at events or brief local organisations
- Stakeholder briefing held 3rd March
- Public exhibition held 4th March (Marloes Community Hall)
- “Open Book Policy” on all data, information and results

# Contacts

Iain Russell

[iain@wavedragon.co.uk](mailto:iain@wavedragon.co.uk)

Hans Christian Sorensen

[Info@wavedragon.net](mailto:Info@wavedragon.net)

David Bean

[db@pmss.co.uk](mailto:db@pmss.co.uk)

[www.wavedragon.co.uk](http://www.wavedragon.co.uk)

YR UNDEB  
EWROPEAIDD  
AMCAN I  
EUROPEAN  
UNION  
OBJECTIVE I

