

IBERDROLA RENEWABLE ENERGIES

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IBERDROLA ENERGÍAS RENOVABLES



IBERDROLA

BACKGROUND



- **IBERDROLA, Spain's second utility, has been historically one of the pioneer companies in the Spanish hydro and wind sectors.**
- **In 2001, with the new Iberdrola Strategic Plan, renewable energies became essential to its business strategy.**
 - **The target is an installed capacity in renewable energy of: 5,500 MW in 2008.**
 - **Spain: 4,500 MW**
 - **International: 1,000 MW**

IBERDROLA RENEWABLE ENERGIES - Development, construction and operation of projects in:



- **Wind Energy** → Actually world leader with 2965 MW of installed power and an annual growth of 650 MW
- **Small Scale Hydro** → 315MW installed and 150MW in development
- **Solar Energy** → More than 450MW in development
- **Biomass** → Studying projects
- **Wave Energy** → Development of a Wave energy power plant off the north coast of Spain.

→ Best performing electricity company in overall analysis of the WWF/Adena ranking in terms of the use of renewable energy.

*Report December 2004

Objective:

To become the world leader in the renewable energy sector

IBERDROLA RENEWABLES - WAVE ENERGY SPAIN



Why is IBERDROLA interested in wave energy?

- IBERDROLA´s strategy regarding renewable energy (5500 MW in 2008)
- IBERDROLA´s target is diversification in renewable energies (today mainly wind and hydro)
- Huge potential of wave energy in Spanish coasts with an average of 25-35 kW/m @ ~900 km which leads to an available wave energy resource of ~20-30GW (175 -250TWh/year)
- Available energy follows energy demand pattern especially in the north of Spain (high wave energy resource between November and March ~70% and ~30% between April and October);
Good grid connections already available because of high industrialization and population density in north of Spain near the coast.
- Relatively good predictability of available wave energy (first estimates several days in advance).

IBERDROLA RENEWABLES - WAVE ENERGY SPAIN



Why is IBERDROLA interested in wave energy?

- Easy scalability because the devices are offshore
 - Understanding of administrative and technical differences to onshore power plants because of its location OFFSHORE:
 - Who are the responsible authorities?
 - Effects of environmental influences (salinity, waves, wind etc.)
 - Remote Control in IBERDROLA'S RENEWABLE ENERGIES OPERATION CENTRE
 - Understanding of operation and maintenance costs and effects.
- especially important because of its transferability to possible future OFFSHORE Wind Farms.
- Local fabrication possible (similar to wind energy industry in Spain).
 - Creation of a local industry and new jobs for ship building industry.
 - Development of technology adaptable to other countries.
 - Low environmental impact.
 - Reduction of emissions of greenhouse gases as specified in the Kyoto Protocol and national guidelines.



RENEWABLE ENERGIES OPERATION CENTRE

IBERDROLA RENEWABLES – SANTOÑA WAVE ENERGY PROJECT



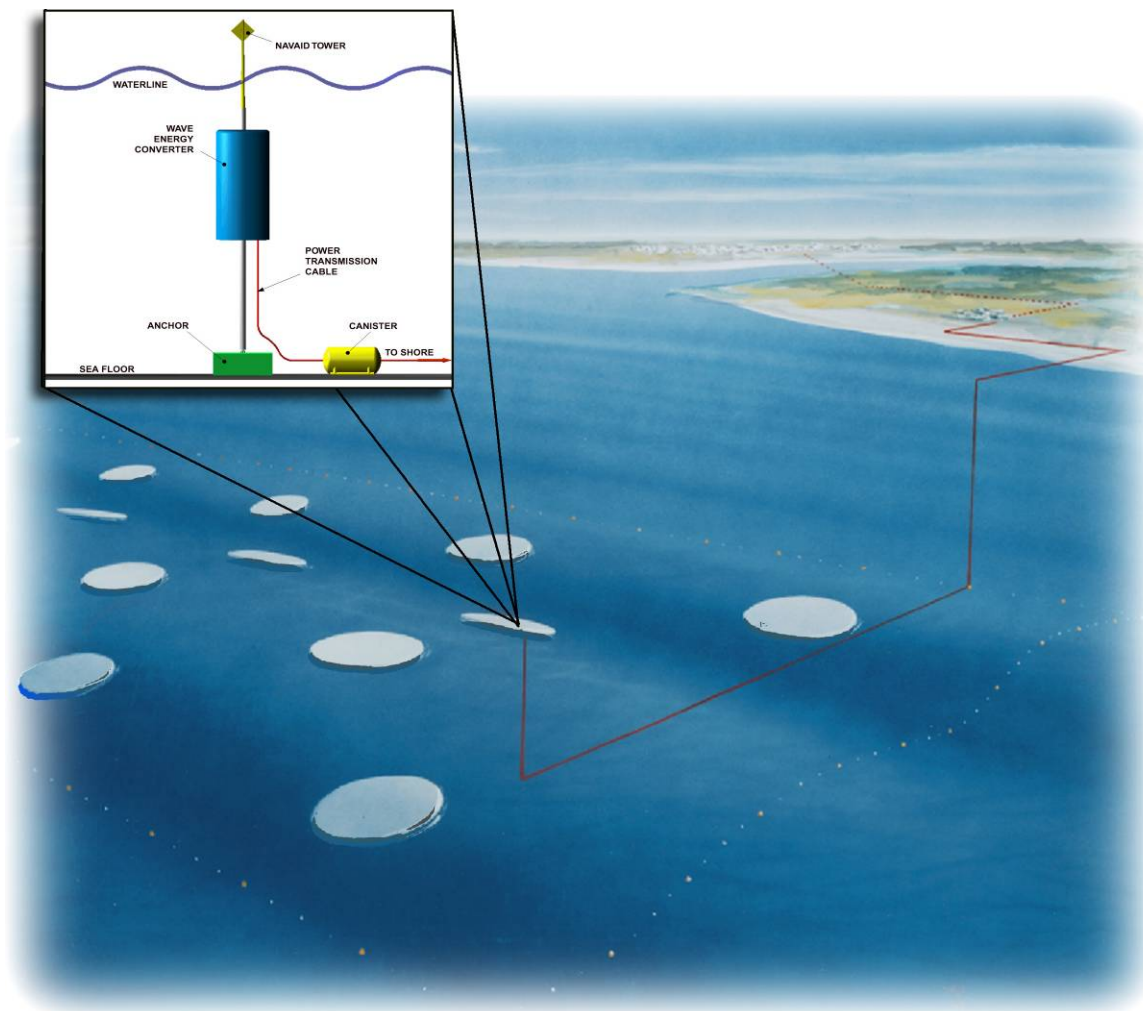
- **Partners of the project:**

- IBERDROLA Renewable Energies - 60%
- Ocean Power Technologies Inc (OPT) -10%
- TOTAL - 10%
- SODERCAN (Cantabrian Regional Development Agency) - 10%
- IDAE (Institute for Energy Diversification and Saving) - 10%

- Collaboration with the University of Cantabria and local, national and international suppliers and service companies.
- Project in development.
- Localization: Cantabria - Santoña, Spain.
- Electric connection: Using submarine electrical cable to light house “Faro del Pescador”.
- Distance to coast : 4km.



IBERDROLA RENEWABLES – OPT SANTOÑA WAVE ENERGY PROJECT Wave Farm



IBERDROLA RENEWABLES – OPT SANTOÑA WAVE ENERGY PROJECT



PowerBuoy™ Deployed off Hawaii - 2004



Santoña - the challenges

- *Wave Climate*
- *Exact Site*
- *Cable Route*
- *Buoy Design*
- *Mooring*
- *Electrical Design*

Wave Climate

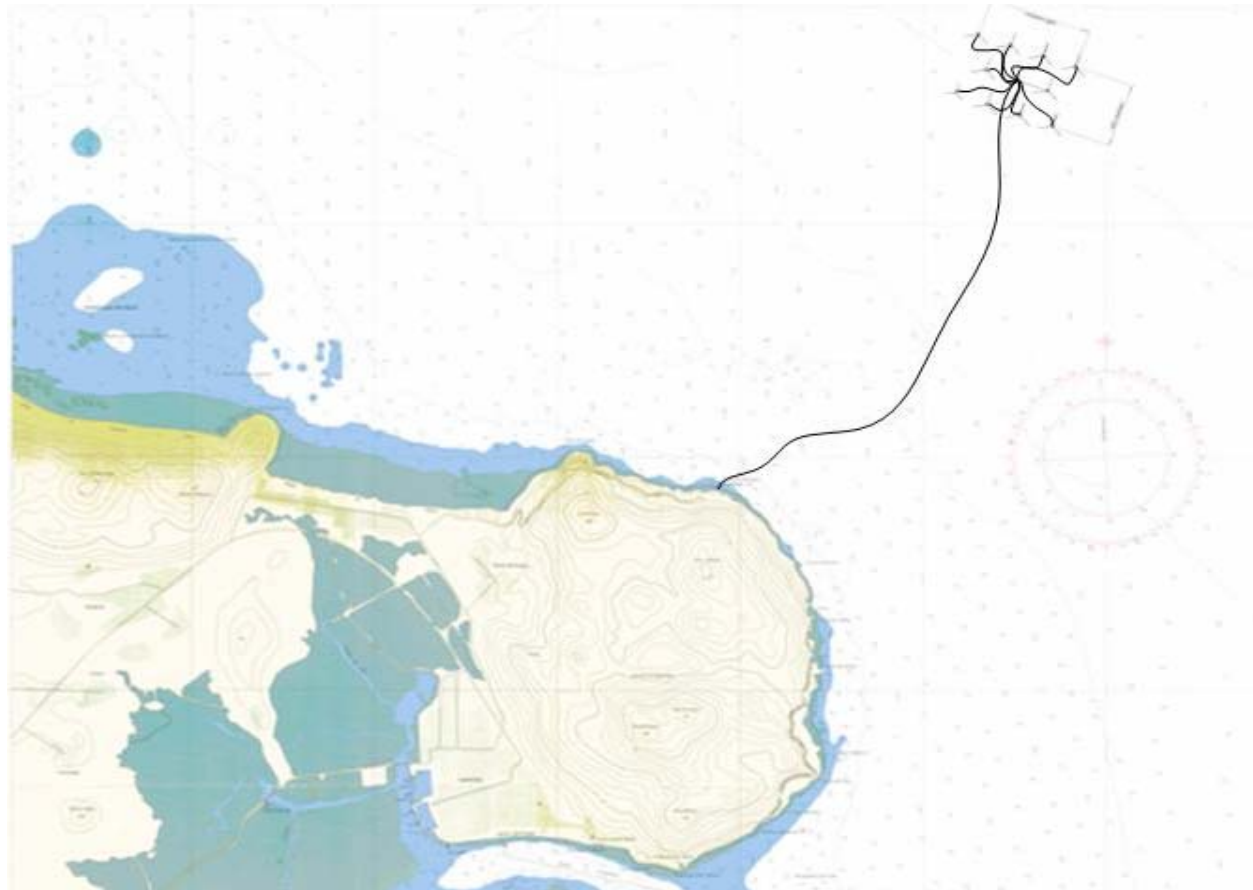
- *Good average power – approx 27.1kW/m*
- *Typical seasonality - stronger in winter*
- *Survivability aimed at 20m wave*
- *19% more power by moving to 50m depth from 30m*
- *Worthwhile if cable not too much longer!*

Exact Site

- *Look for 50 m depth*
- *Minimize cable route to connection point (lighthouse)*
- *Contrast longer run to beach vs. shorter run up cliff*
- *Identify bottom conditions for mooring and cable lay*
- *Fix site location – 4km off-shore*
- *Work out route for cable and laying method*

IBERDROLA RENEWABLES – OPT SANTOÑA WAVE ENERGY PROJECT

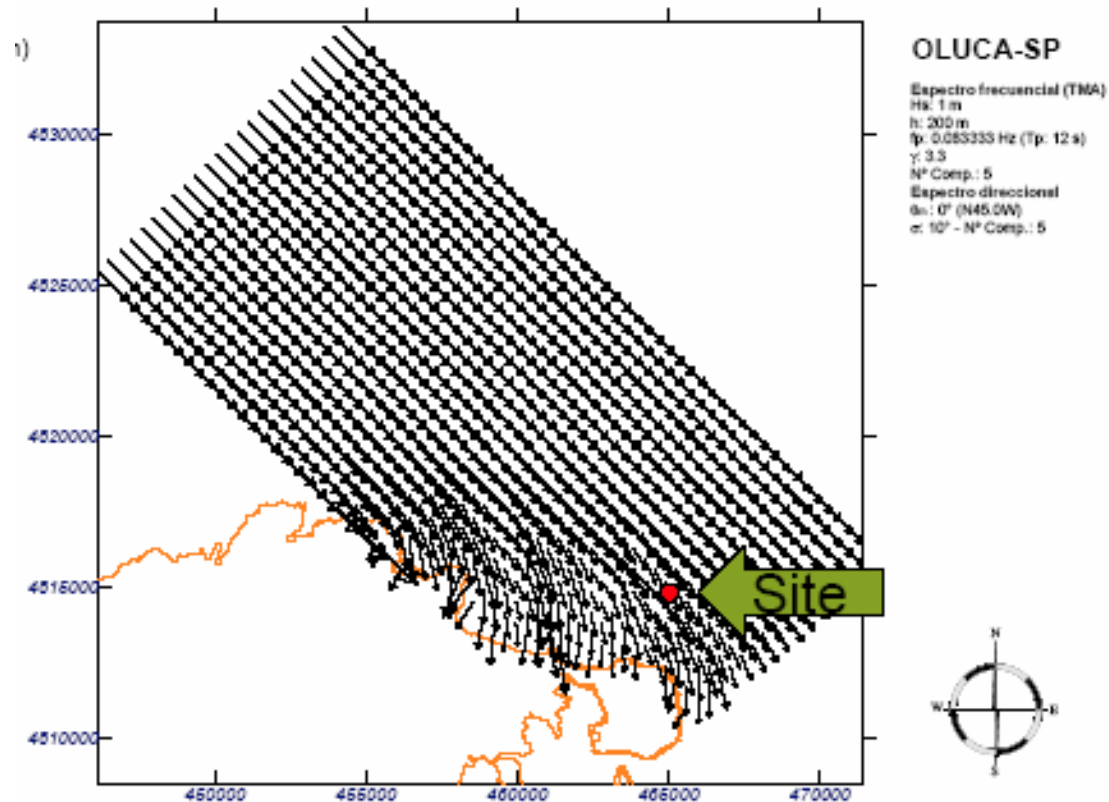
Exact Site and Cable Route



IBERDROLA RENEWABLES - OPT SANTOÑA WAVE ENERGY PROJECT



Bathymetry and Wave Vectors at the site



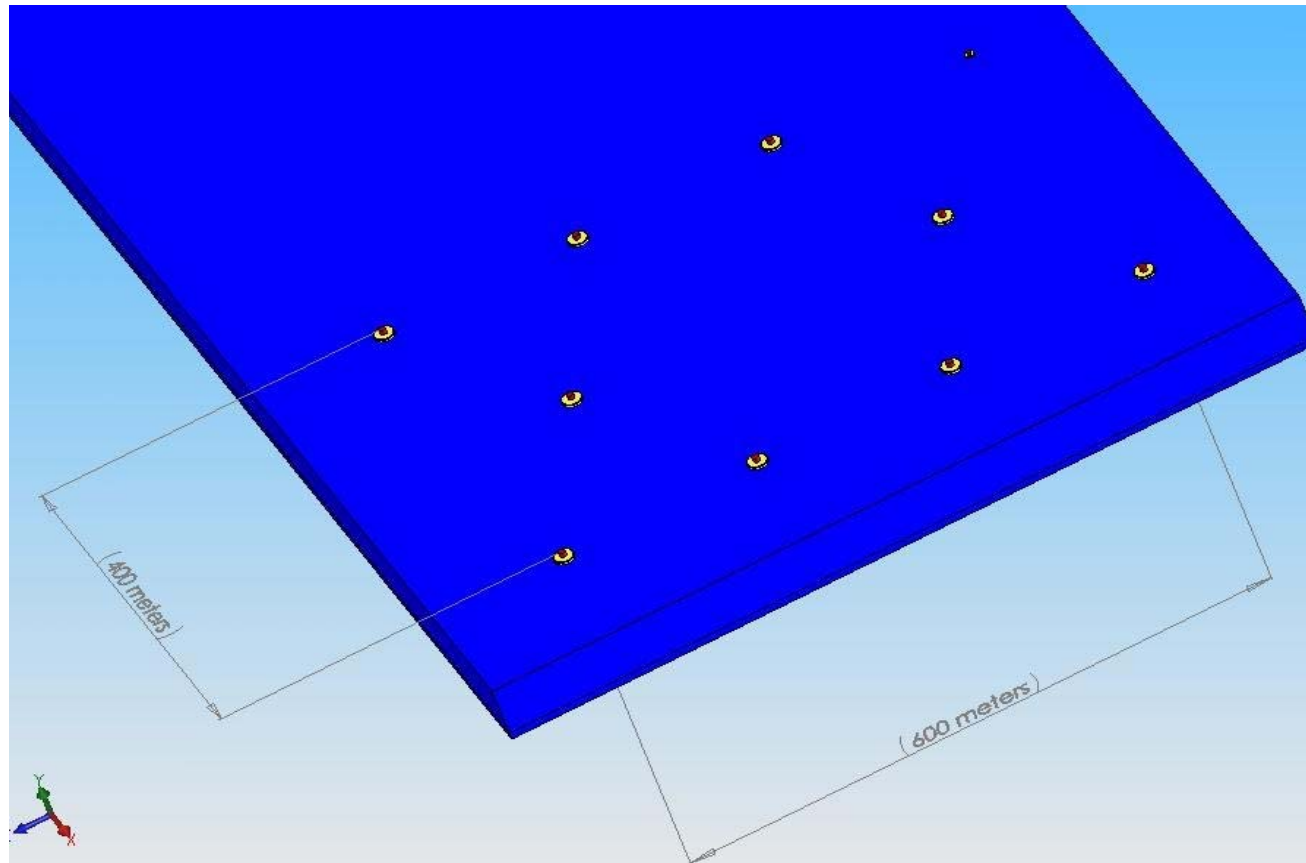
Buoy Design

- *Site has 5.5m tidal range*
- *50 m depth attractive for power output*
- *Floating design chosen, based on concept developed for Autonomous Power Buoy*
- *Benefits include easier deployment and lower weight (Cost)*
- *1 x 40kW PowerBuoy followed by 9 x 150kW*

IBERDROLA RENEWABLES – OPT SANTOÑA WAVE ENERGY PROJECT



Buoy Field Design

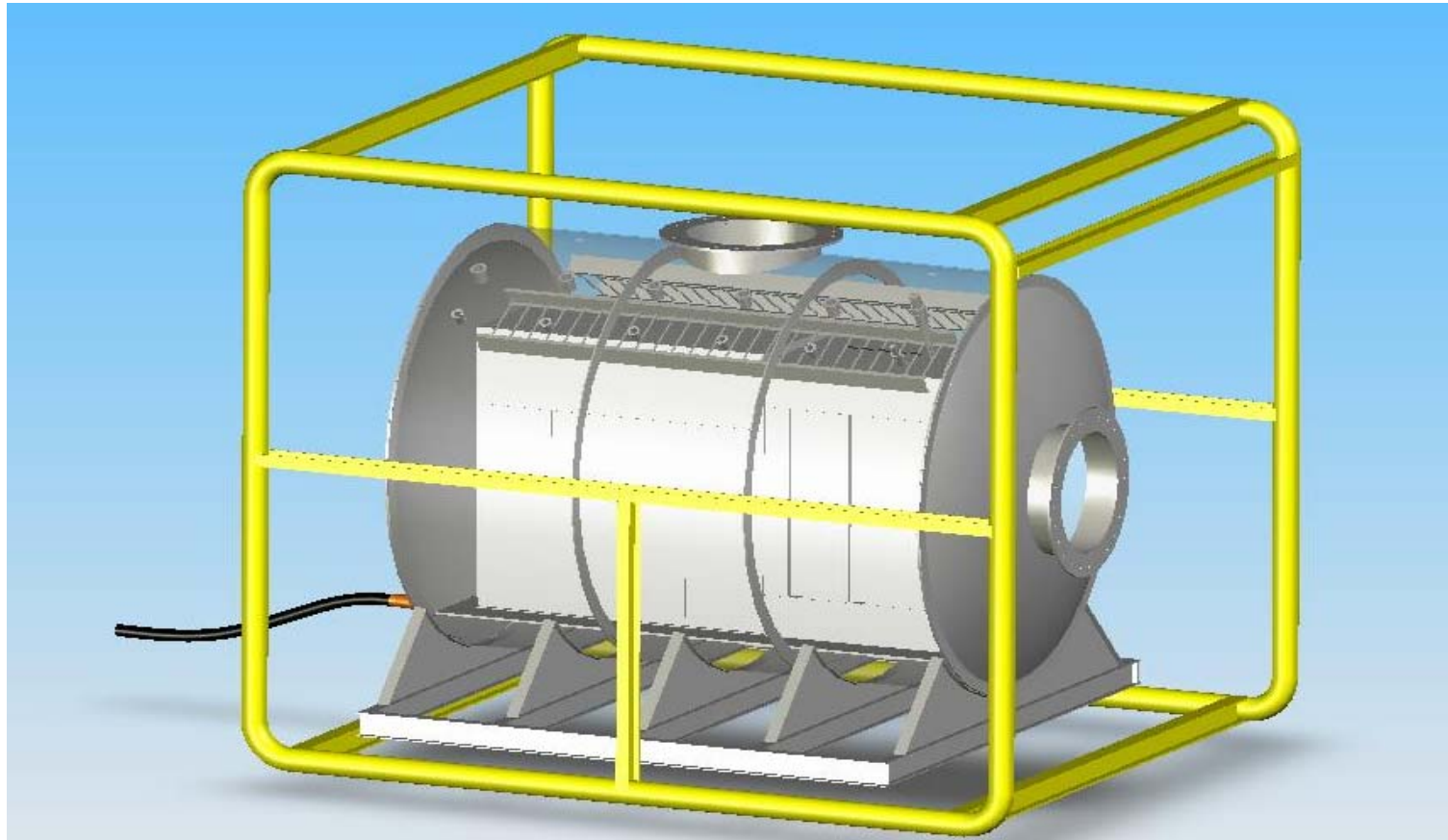


Electrical Design

- *Many options considered to get power ashore.*
- *Even for 1.5MW over 4km, HV AC is best (12kV).*
- *Do not want HV AC on individual buoys – therefore 600V flexibles to each 150kW buoy.*
- *Cables connect to underwater submerged substation, housing switchgear and HV transformer.*
- *Flexibles have wet-mateable connections for removal of cables if required.*
- *Protection system designed and agreed with local distribution company.*

IBERDROLA RENEWABLES - OPT SANTOÑA WAVE ENERGY PROJECT

Underwater Sub-station



Next Steps

- *OPT PowerBuoy development continues*
- *Santoña scheme detailed design underway*
- *Most design challenges tackled*
- *Construction due 2006 onwards - local fabrication*
- *Expansion being discussed...!*
- *Similar concept planned for France, UK etc*

CONTACT US



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