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# WindFloat Pacific OSW Project

BOEM Workshop
Sacramento, CA
July 29, 2014

# The WindFloat

## Turbine Agnostic

- Conventional: 3-blade, upwind
- Partnership with manufacturers
- No major redesign
  - Control system – software
  - Tower – structural interface

## Static Water Ballast – Stability

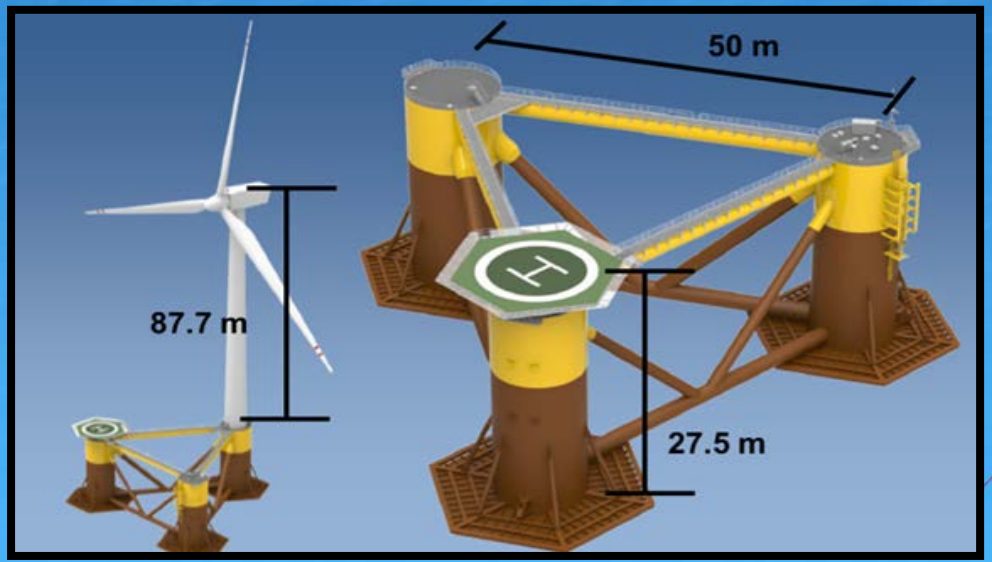
- Used to achieve operating draft

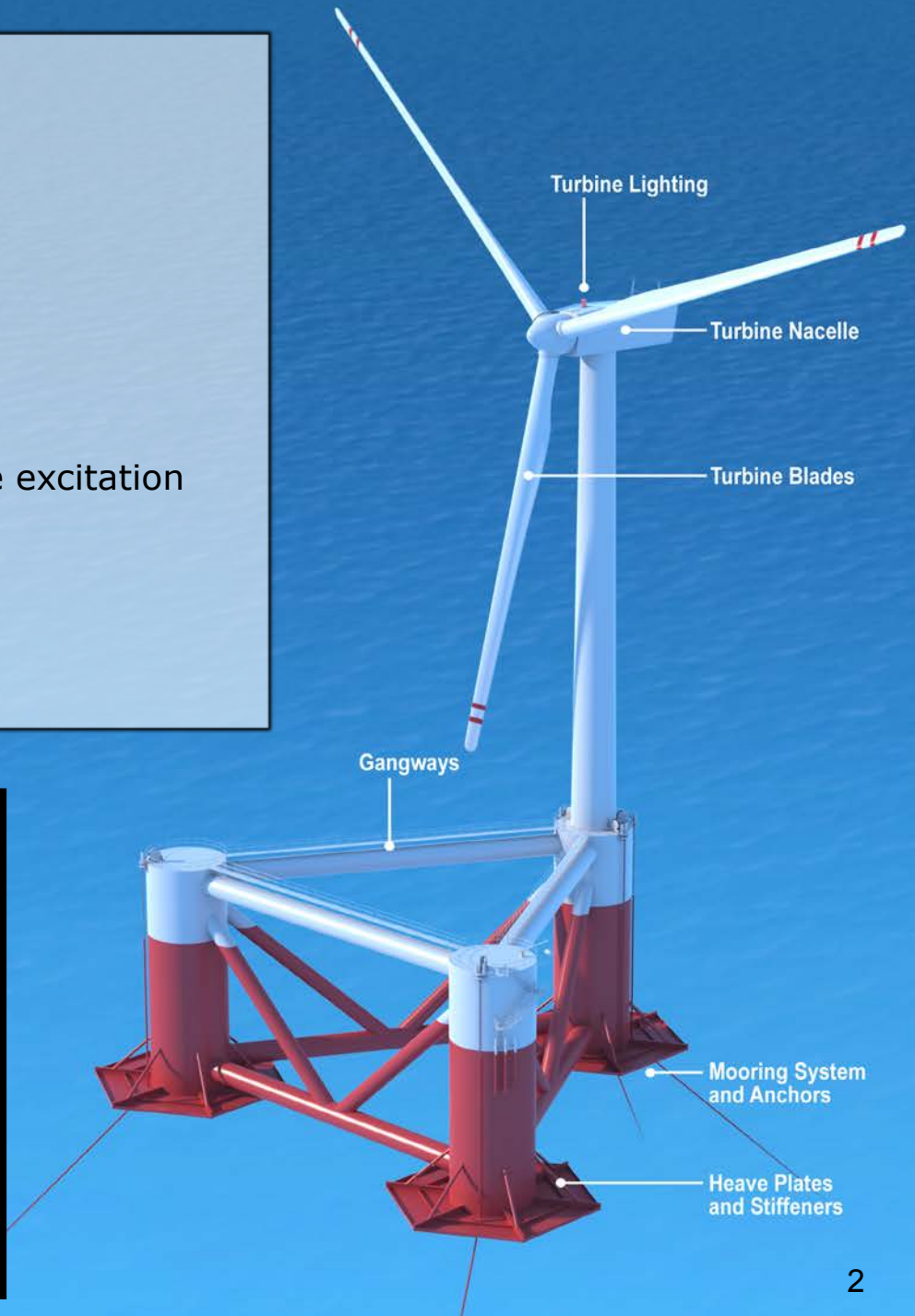
## Heave Plates – Dynamic Stability

- Move platform natural response above the wave excitation (entrained water)
- Viscous damping reduces platform motions

## Hull Trim System – Efficiency

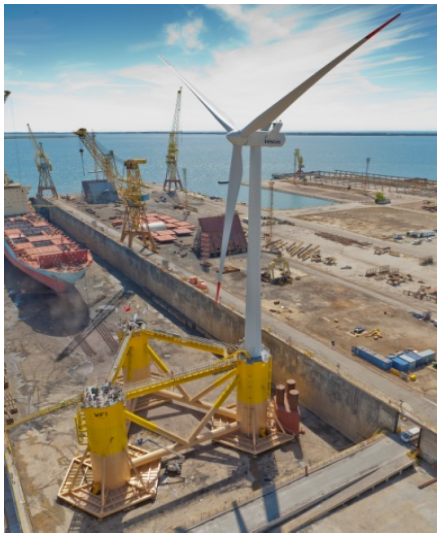
- Tower is vertical – No mean pitch
- Closed-loop with redundant path



# WindFloat 1: Successfully Operating for Over 2.5 Years

- Installed off of Northern Portugal in October 2011; still producing today
- Generated and delivered over 10 GWh of energy to Portuguese Grid
- Technical availability over 93%
- Performed through extreme weather events, including waves over 15m
- Energy output consistent with onshore turbine under same wind conditions



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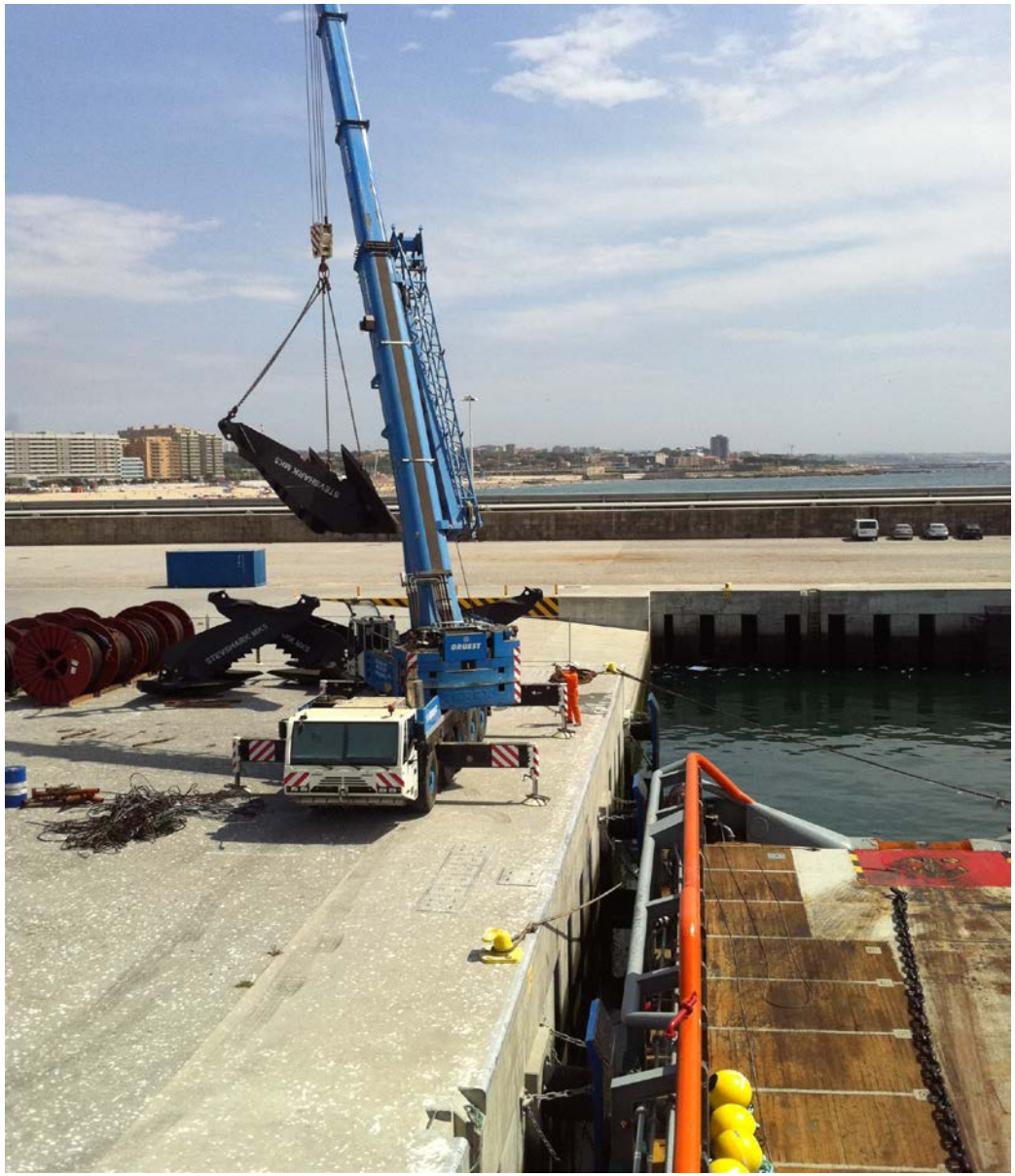
# WF 1 - Anchors



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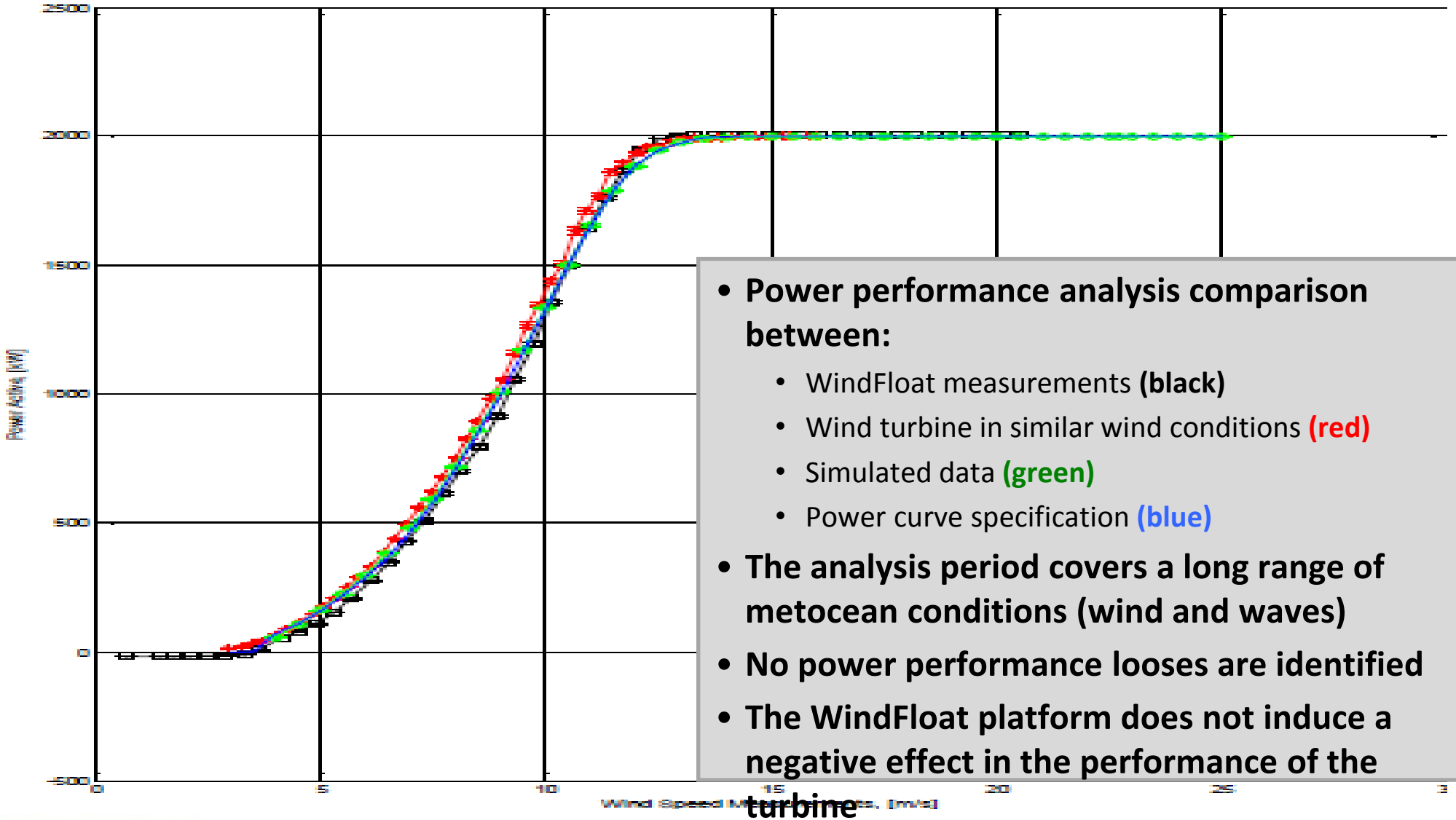
# WindFloat 1 - Performance Demonstration

**Power Curve performance**




- **Power performance analysis comparison between:**
  - WindFloat measurements **(black)**
  - Wind turbine in similar wind conditions **(red)**
  - Simulated data **(green)**
  - Power curve specification **(blue)**
- **The analysis period covers a long range of metocean conditions (wind and waves)**
- **No power performance looses are identified**
- **The WindFloat platform does not induce a negative effect in the performance of the turbine**

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# WindFloat 1 - Performance Demonstration

## Extreme events

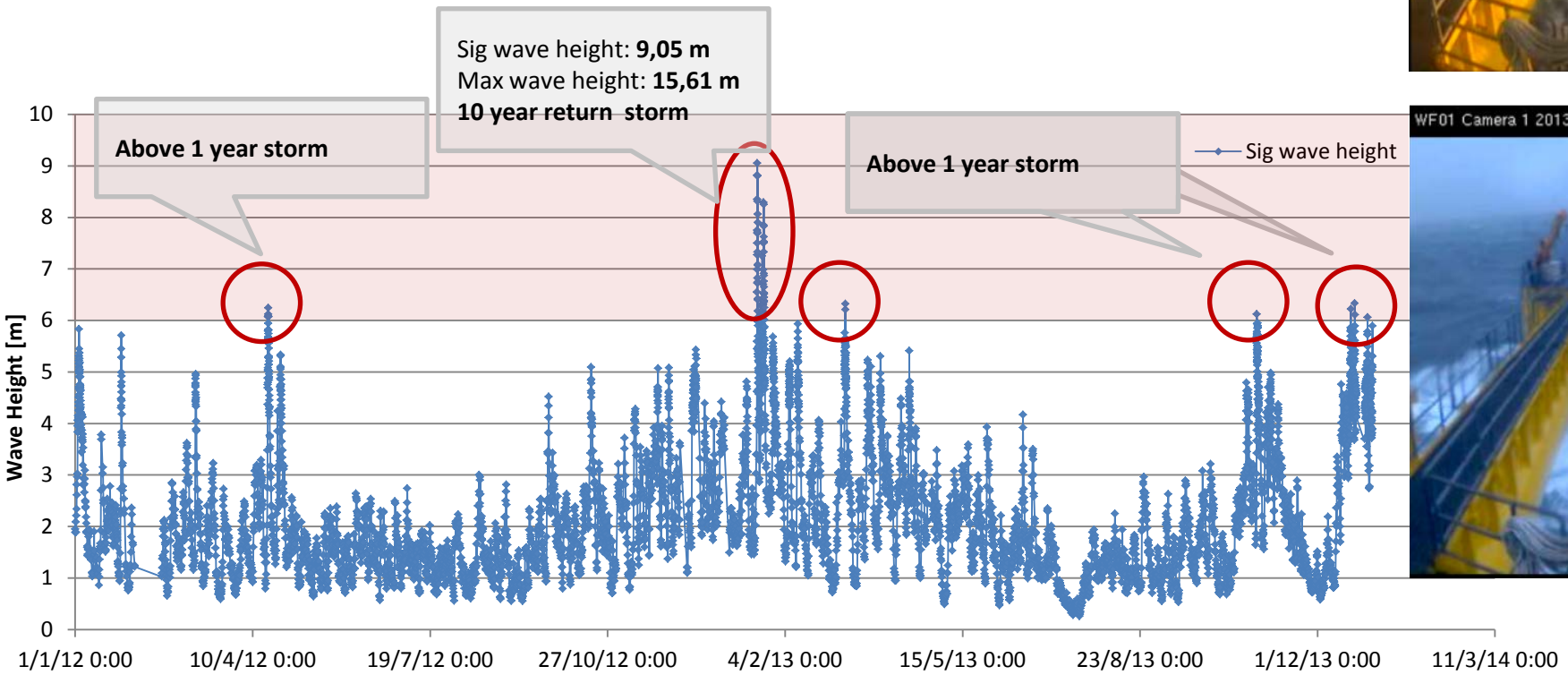
During 2012 and 2013 extreme weather conditions were faced

- Max wave height ≈16 m
- No structural damages

WindFloat 1 - was designed to operate up to 6.6 m significant wave height

- This limit was exceeded only 1% of the time during the year resulting in low unavailability due to weather conditions





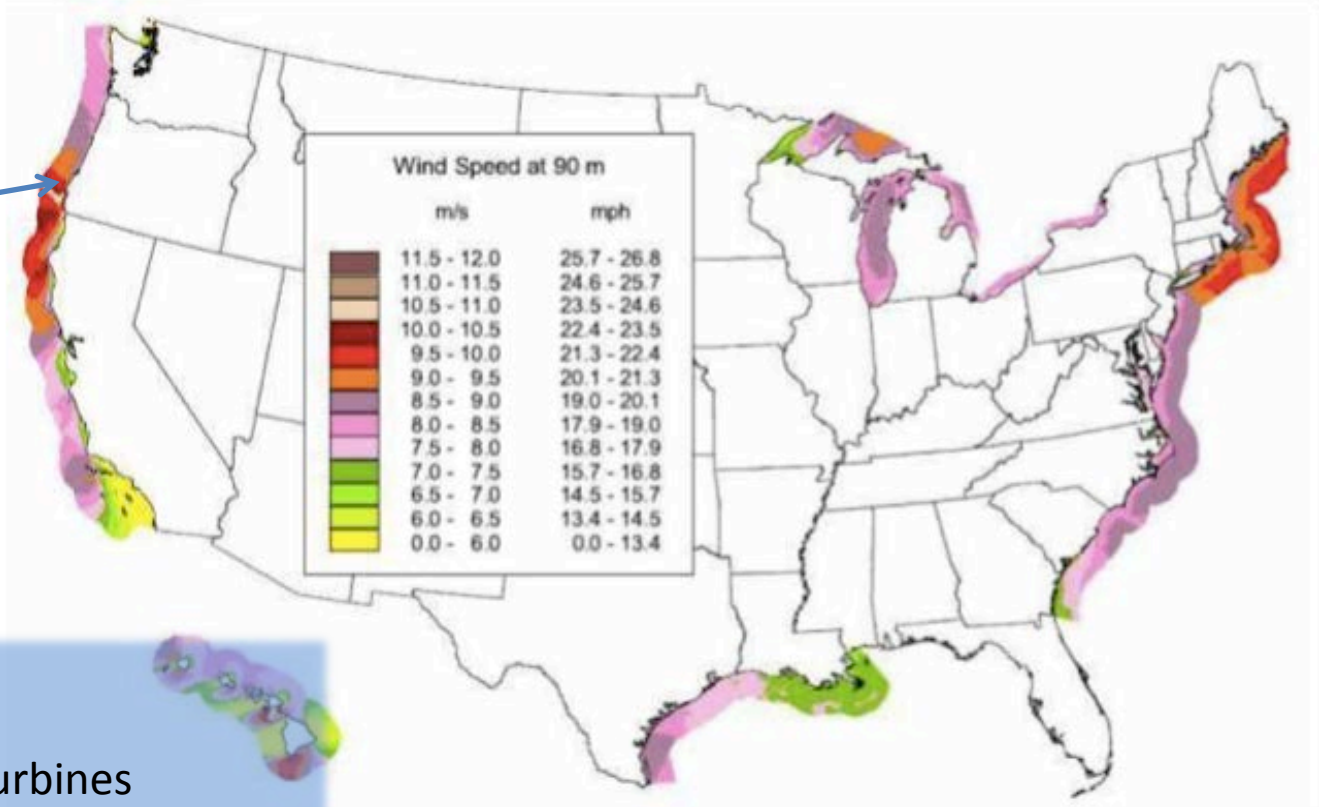

NOVEMBER 3RD,
STORM #1 2011
Hs > 8m
Hmax > 15m

# WindFloat Pacific – Global Sizing Scale-up 2MW to 6MW

| Dimensions | 2MW Prototype | 6MW |
|---|---|---|
| Rotor Diameter | 80m | 154m |
| Draft | 13.7m | 18m |
| Tower height | 56m | 88m |
| Column height | 23.2m | 27.5m |
| Column diameter | 8.2m | 10.5m |
| Column to column | 38m | 50m |
| WEP Length | 12m | 13.2m |
| Displacement | 2800tonnes | 6000tonnes |

# WFP: Unlocking the West Coast Offshore Wind Potential

OREGON INTERNATIONAL Port of Coos Bay




- Up to 30 MW
- Up to Five WindFloats with 6MW + turbines
- 18 miles due west of Coos Bay, Oregon
- 350 meters water depth
- 25 year project life
- To be commissioned by end 2017

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# WFP: Alignment with DOE Objectives

## Infrastructure and Supply Chain

- Validate and identification future West Coast infrastructure to support US offshore wind energy development
- In depth study and analysis of serial production benefits of the WindFloat technology

## Deepwater Offshore Wind Resource Assessment

- Development and validation of a method suitable for deepwater locations
- Design basis development and energy generation predictions

## Deployment of state of the art 6MW+ wind turbines offshore

## Offshore Installation and O&M

- Multiple offshore wind turbines and transmission infrastructure without ANY offshore lifting or piling activities
- Design and analysis of offshore O&M methods and procedures for floating wind

## First step in establishing an industry

# WFP: Innovations

## Larger capacity, 6MW+ Turbine

- Direct drive turbines increase energy capture and improve reliability

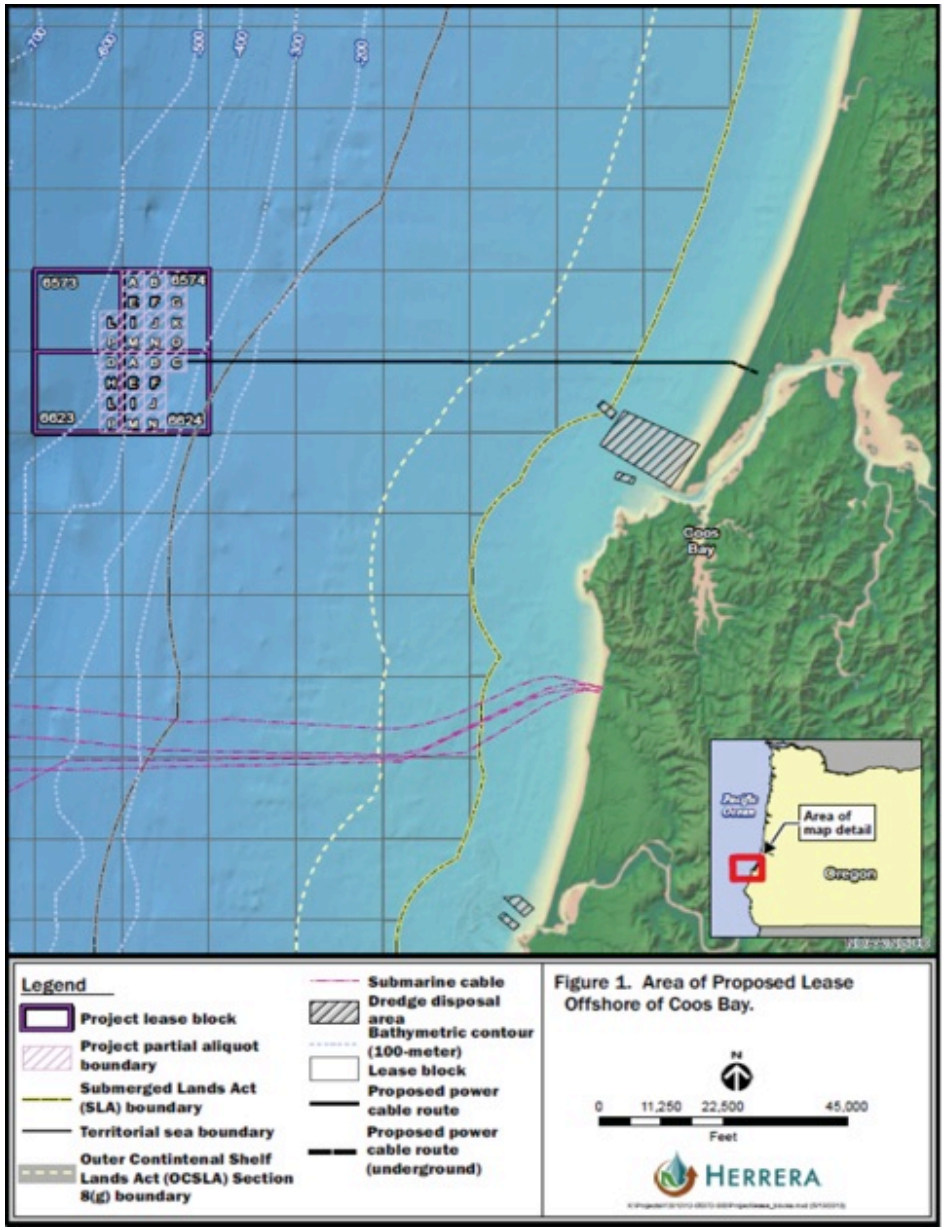
## Floating Support Structure

- Stable, cost effective floating platform
- Structurally decoupled from bottom conditions
- Float out installation process utilizes inexpensive, widely available, Jones Act-compliant vessels
- Tow-to-shore option for major repairs reduced O&M costs and increases uptime
- Quayside installation and commissioning of turbines to reduce commercial and schedule risks

## 25-year design life increases lifetime generation and reduces financing costs

## Simple decommissioning process reduces costs and improves safety

# WFP: Key Location Features



# WFP: Key Location Features

## Strong wind resource

- Annual NCF ~ 42.5%

## Deep water offshore

- Generally sandy/silty bottom
- Avoidable rocky outcroppings

## Industrial community

- Deep, protected harbor
- No Air-draft issues

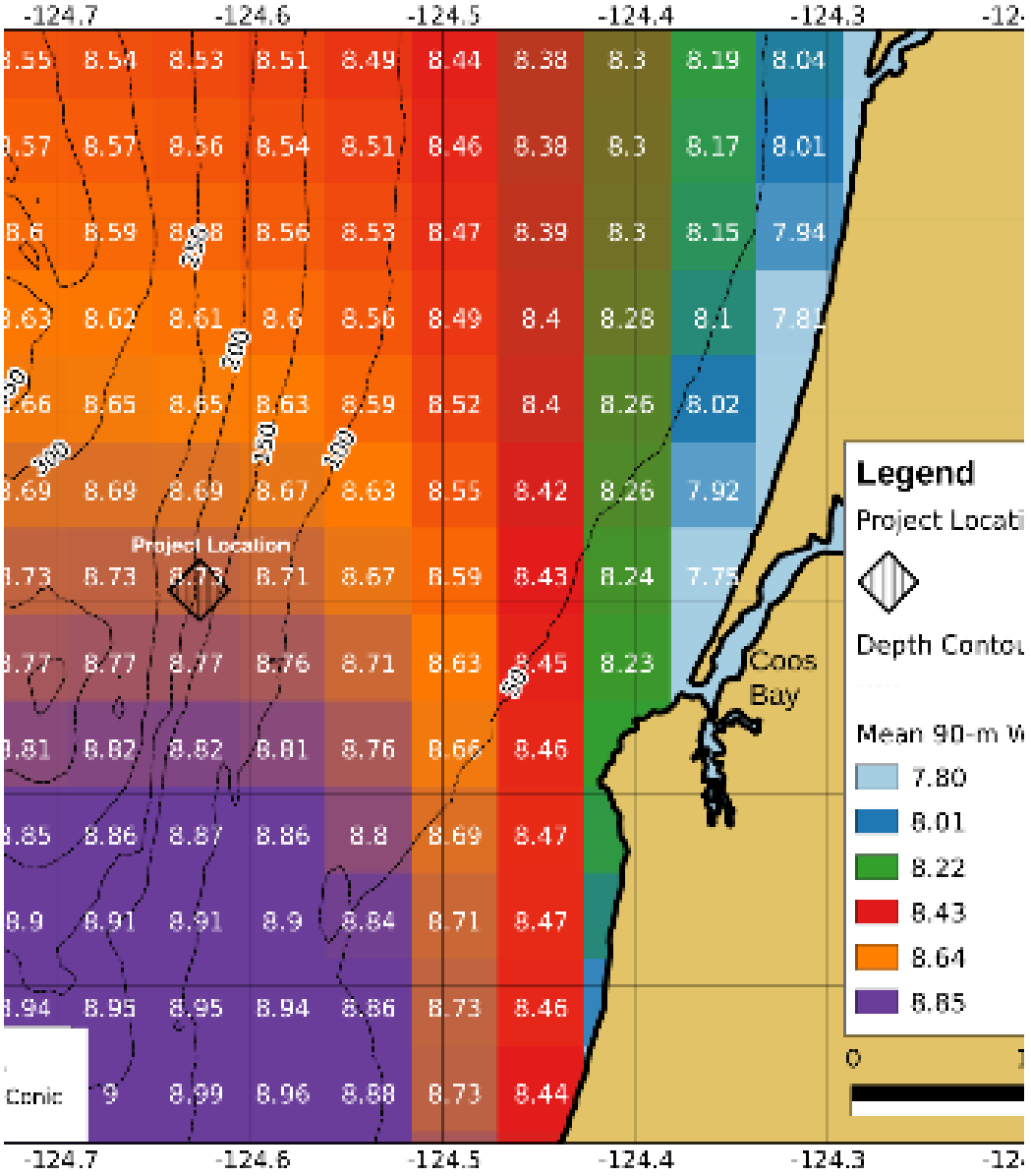
## Organized Fishing Presence

- Consensus on project location

## Existing BOEM state task force (OR)

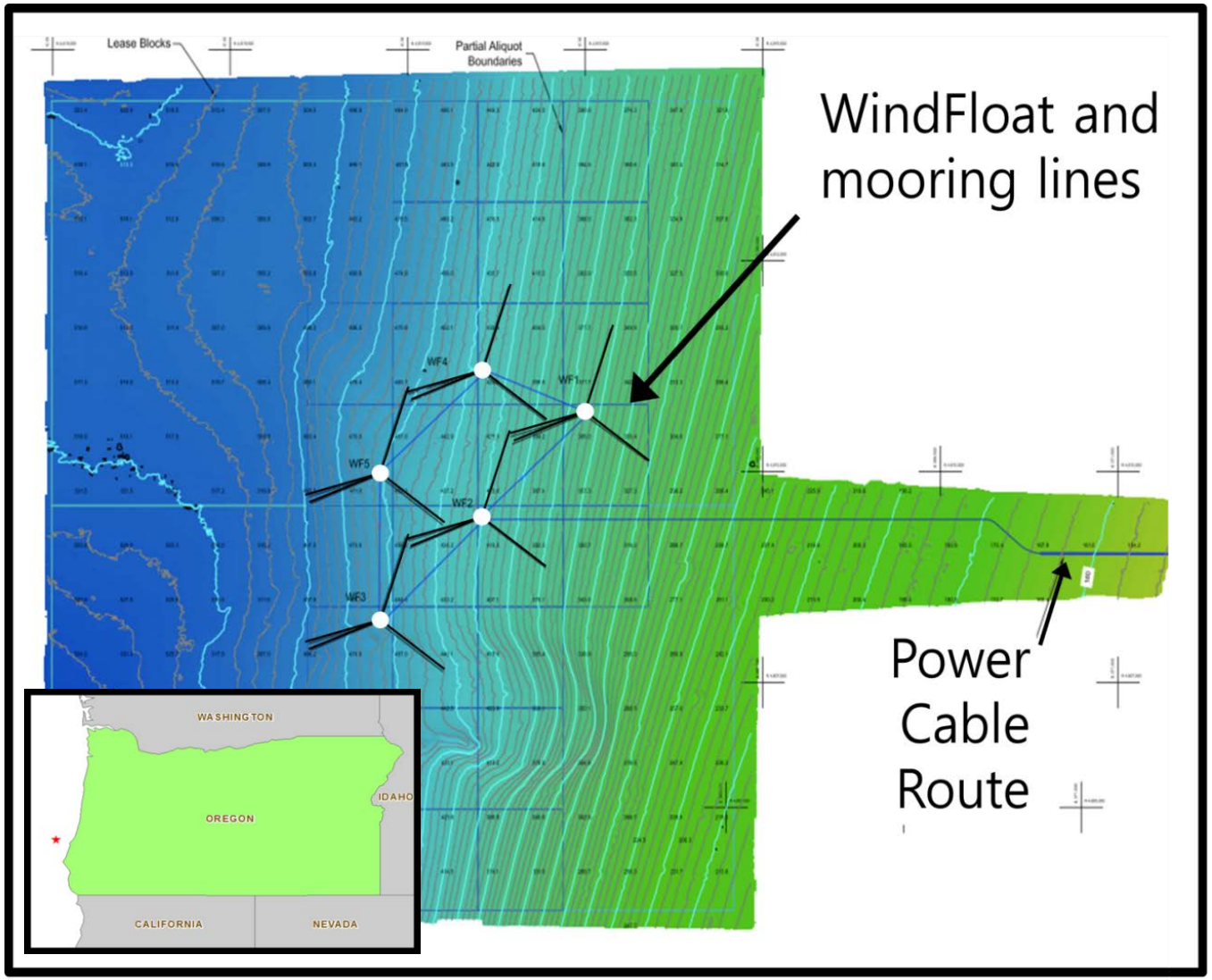
## Favorable state policy disposition

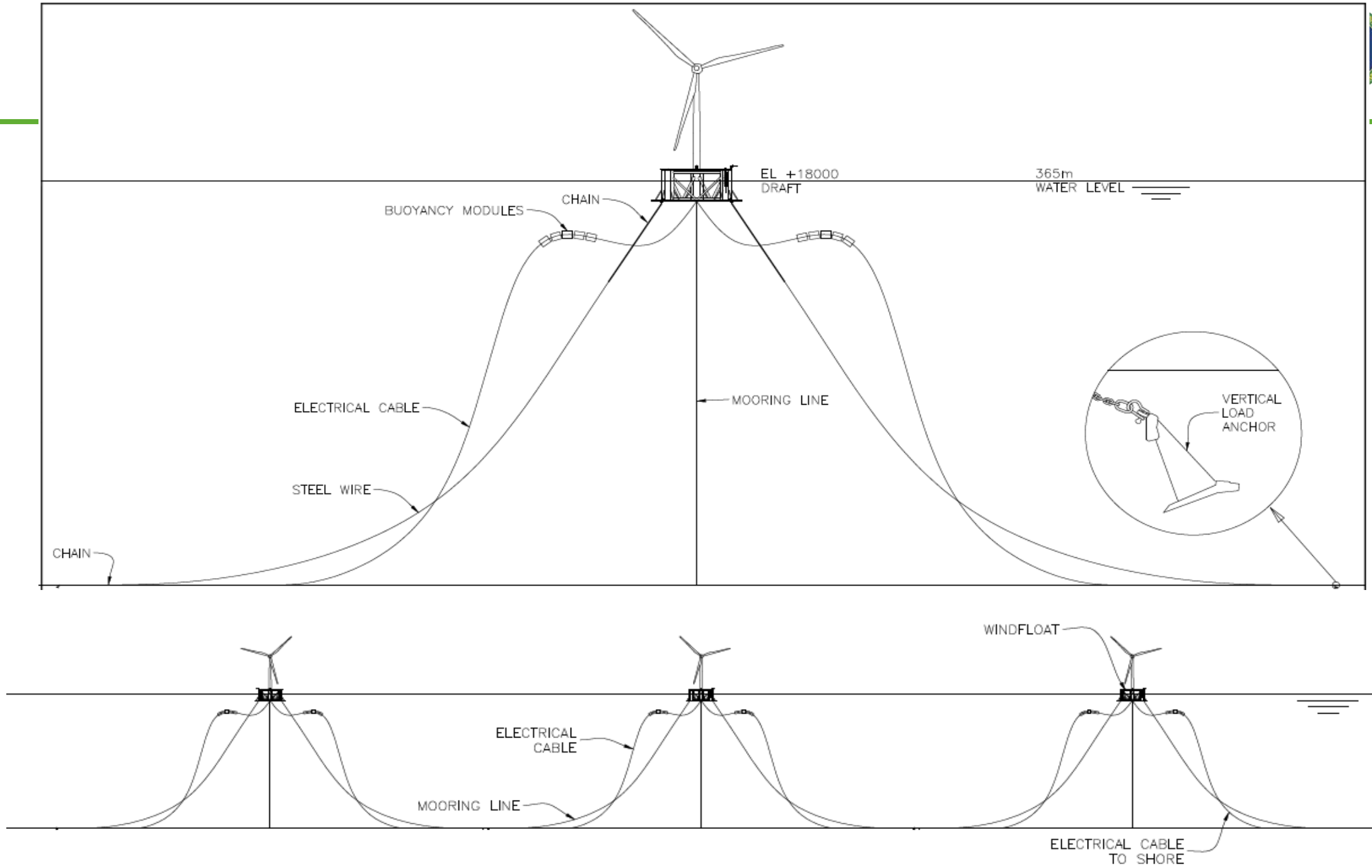
- Renewables/ocean energy
- Market pull from Regional Utilities



# Proposed Project Site

- Lease application filed with BOEM May 14th 2013
- Application area for OCS lease blocks (and aliquots) to BOEM
- ~18 miles offshore
- Project will be in about 350+ meters (~1200 feet) of water
- Generally sandy/silty bottom






Preliminary WFP Mooring Configuration

# WFP: Visual Effects: Turbines off coast of Coos Bay

View from cable landing

Zoomed approximately 4 times

**Views from other shore locations will be very similar (for example Gregory Point)**

# Addressing Concerns and Modifications to the WFP Project

| Concern | Modification |
|---|---|
| Interference with commercial fishing activities | Project site moved from ~10 miles offshore to approximately 18 miles offshore to reach 200 fathom depth. |
| Threats to migratory seabirds | Turbine blades will rotate at a minimum of 30 m above sea surface; no further changes needed. |
| Presence of Wind Floats potentially threaten marine mammals, sea turtles, and fish | Gather all available data on presence of marine animals. Determined that most migratory species are not present in large numbers; no changes needed. |
| Concerns about viewshed from culturally sensitive lands off Gregory Point | Additional visual effect studies will be conducted to demonstrate how small turbines will look 18 miles offshore. |
| Concerns about habitat destruction of rocky reefs on the WFP site and along cable route | Bathymetric surveys and sub-bottom profiling surveys used to identify sensitive areas; cable route modified to traverse around identified rocky reef. |

# WFP: BP1 Objectives and Accomplishments (~$4M)

## 50% FEED ✓

- ABS Approval in Principle in hand

## Site Identification ✓

- Endorsement from Local Fishing Fleets

## Initiate Permitting Process ✓

- DNCI from BOEM establishes site control
- Aggressive Approval Schedule: Permits in Hand Q2 2016

## Public Approval ✓

- Explicit Committed Support from NW Governors and stakeholders

## Project Finance and Future Cost-share ✓

- Deepwater Wind's experience structuring off-takes and raising capital

# WFP: BP2 Objectives (Q3 2014 – Q2 2015) (~$6.7M)

## Engineering & Design

- 100% FEED
- Fabrication strategy identified and vendor quotes received

## Installation, O&M

- Installation procedures and O&M methodology documented

## NEPA & Permitting

- Material progress on major regulatory processes
    - Submission of Construction and Operations Plan (COP)
    - Lease issuance (target Q2 2015)

## Off-take & Grid Interconnection

- Material progress on off-take agreements
- Material progress on interconnection studies/agreement

# WFP: BP3 - 5 Objectives (Q3 2015 - Q4 2017) (~$40MM)

Acquisition of all permits

Execution of contracts

Ordering of steel and components (i.e. turbines)

Fabrication, Delivery, Assembly

Installation

Commissioning

**- Expected Commissioning before end 2017 -**

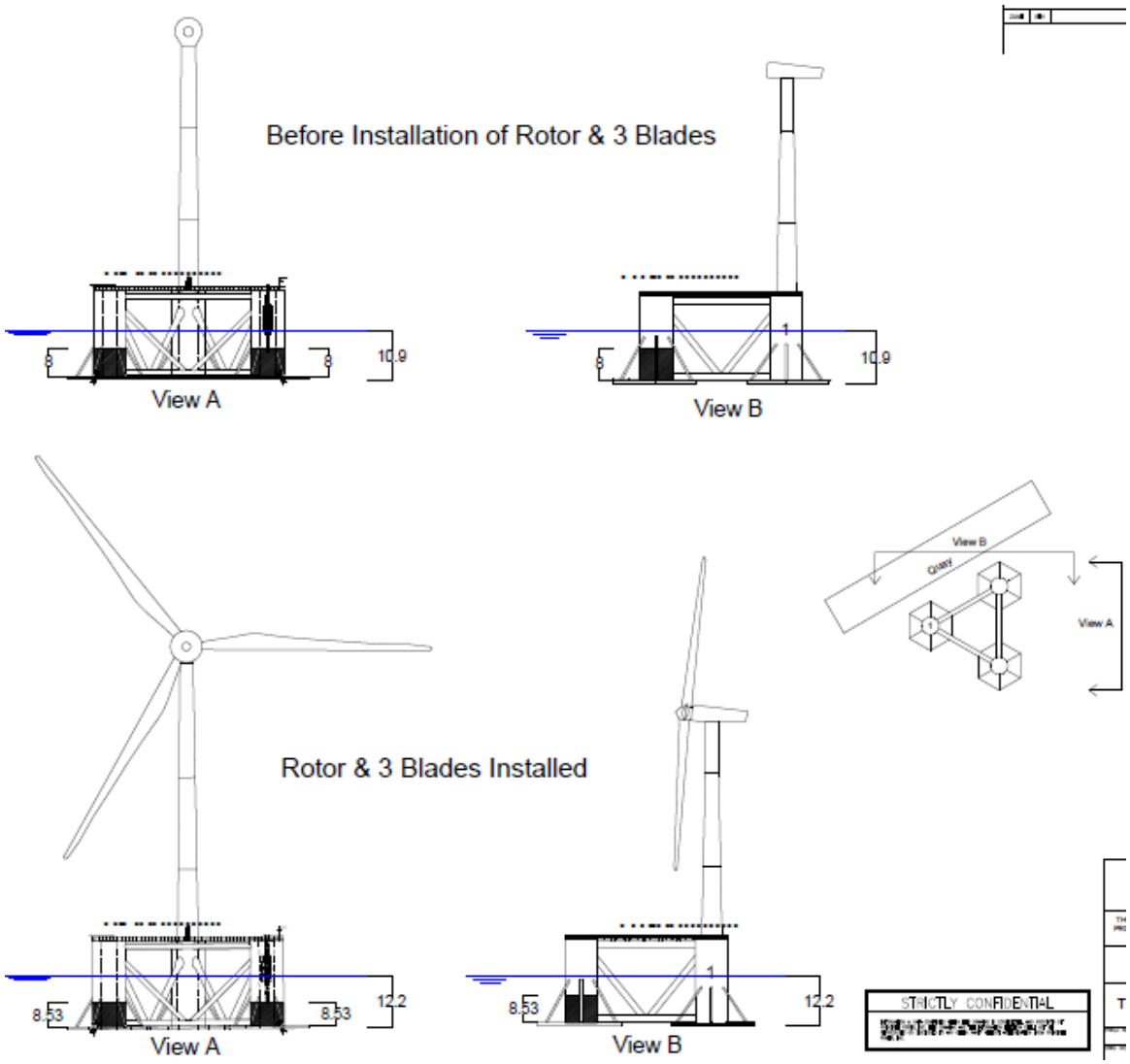
Post – installation monitoring campaign

# WFP: Turbine Installation at Quay Side

## Quay Side Installation

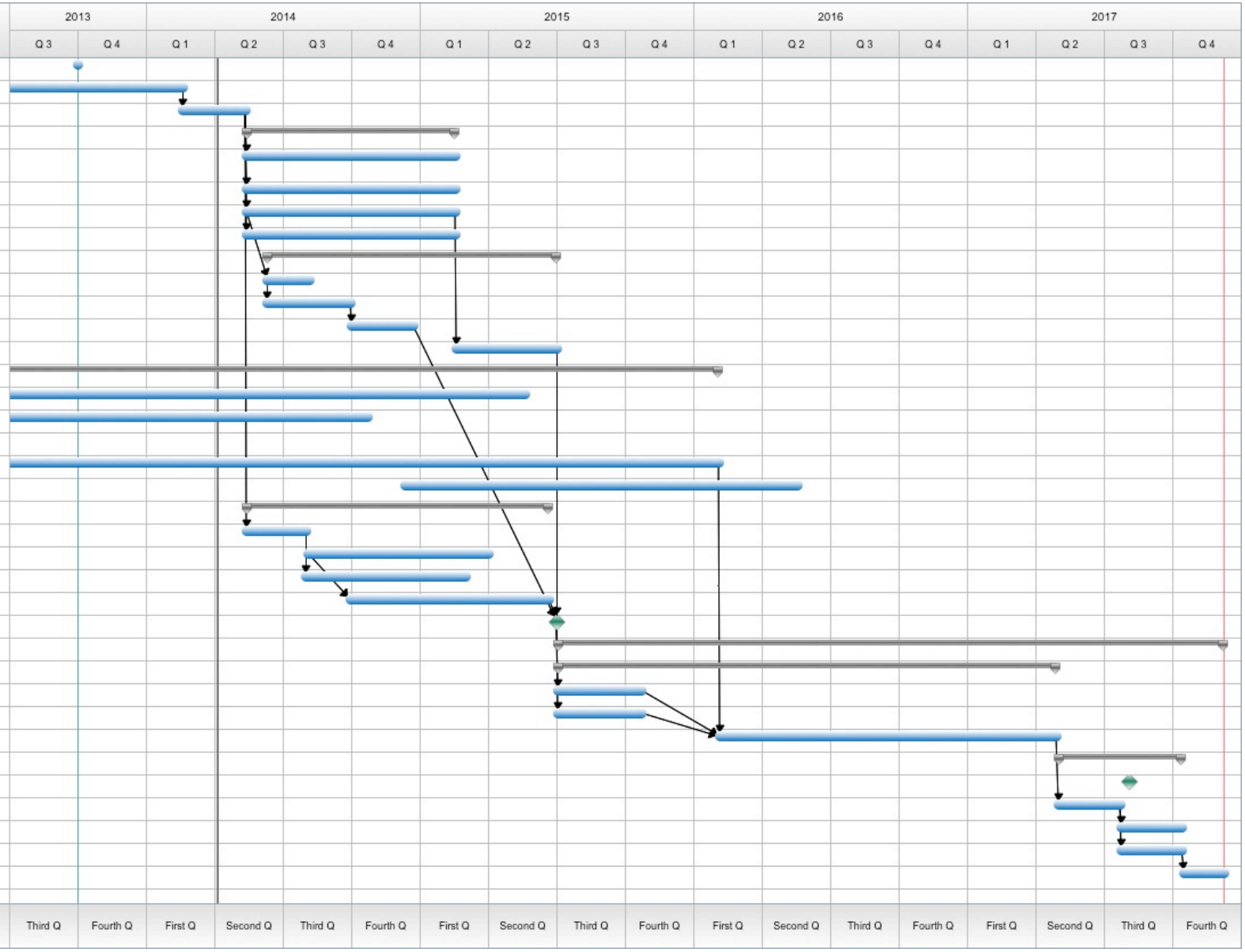
- In Coos Bay
- No special vessel
- Floating platform
- (Ballast water to keep platform even-keeled while transiting from 6 to 12m draft)
- Shore requirements:
  - Water depth > 12m
  - No dredging / civil works
  - Crane at quay (may be rented)

**Time Frame:**
2 days / platform
Weather independent in summer



# WFP – Schedule: Aggressive but Achievable

| Activity Name | Start Date | Finish Date |
|---|---|---|
| WindFloat Pacific | 10/1/13 | 10/1/13 |
| 50% FEED | 1/1/13 | 2/17/14 |
| Downselect | 2/18/14 | 5/12/14 |
| **100 % FEED** | **5/13/14** | **2/16/15** |
| Turbine engineering (turbine vendor) | 5/13/14 | 2/16/15 |
| Cable engineering (3rd party) | 5/13/14 | 2/16/15 |
| Hull & mooring engineering | 5/13/14 | 2/16/15 |
| 3rd party certification | 5/13/14 | 2/16/15 |
| **Procurement/Detail Design** | **6/10/14** | **7/1/15** |
| RFQ preparation | 6/10/14 | 8/4/14 |
| Vendor quotes | 6/10/14 | 9/29/14 |
| Vendor selection | 9/30/14 | 12/22/14 |
| Detail design | 2/17/15 | 7/1/15 |
| Permitting | **3/27/13** | **2/3/16** |
| OCS Lease Application | 3/27/13 | 5/19/15 |
| Site Characterization/Env Studies | 3/27/13 | 10/21/14 |
| COP | 3/27/13 | 3/27/13 |
| NEPA Document | 5/2/13 | 2/3/16 |
| Interconnection studies | 12/11/14 | 5/17/16 |
| Project Financing | **5/13/14** | **6/19/15** |
| JV Formation | 5/13/14 | 7/31/14 |
| PPA Negotions | 8/4/14 | 3/31/15 |
| EPC Negotiations | 8/1/14 | 3/2/15 |
| Funding arrangements | 9/29/14 | 6/19/15 |
| **FID** | **7/1/15** | **7/1/15** |
| **Execution** | **7/2/15** | **12/8/17** |
| **Fabrication** | **7/2/15** | **4/28/17** |
| *Order steel* | 7/2/15 | 10/21/15 |
| *Fabrication drawings* | 7/2/15 | 10/21/15 |
| *Hull fabrication* | 2/4/16 | 4/28/17 |
| **Installation** | **5/1/17** | **10/13/17** |
| *Export cable* | 8/3/17 | 8/3/17 |
| *Mooring pre-lay* | 5/1/17 | 7/21/17 |
| *Inter-array cable* | 7/24/17 | 10/13/17 |
| *Towing and hook-up* | 7/24/17 | 10/13/17 |
| **Commissioning** | **10/16/17** | **12/8/17** |



# WFP: Explicit, Committed NW State Support

## Oregon Governor John Kitzhaber

*"We are committed to working with Principle Power to responsibly site this project, and ensure that they can move through the state permitting process in a timely and efficient manner. We commend Principle Power for their effort to engage a diverse group of stakeholders, particularly the fishing community, in identifying their proposed site. We also support the arrangement of power purchase agreements with parties in our state, overcoming one of the key challenges for new energy technology development."*

STATE OF WASHINGTON
Office of the Governor

## Washington Governor Jay Inslee

*"While costs of energy from demonstration scale projects are typically above market, our state requirements and incentives encourage development and investment in these types of projects, while successfully creating new jobs. I am committed to further enhancing conditions within our region to support the wide scale use of clean energy resources…I urge you to continue supporting WindFloat Pacific."*

# WFP - a Pilot for Larger West Coast Developments

## Retirements of fossil and nuclear power plants

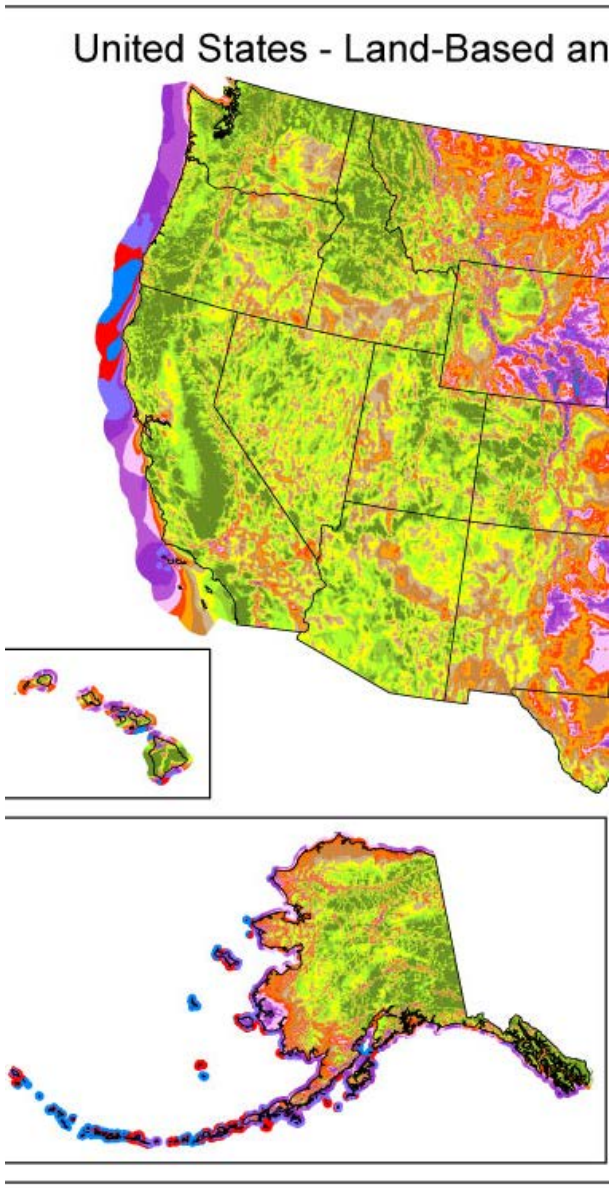
- Creates near-term need for large-scale resources
  - San Onofre, CA – 2150 MW
  - Boardman, OR – 550 MW
  - Centralia, WA – 1340 MW

## West Coast has excellent offshore wind resource

- Can deliver energy directly into densely-populated coastal areas
- Winter peaking supply corresponds to peak demand periods

## Like BIWF, WFP is critical to the West Coast to

- Build capabilities
- Demonstrate feasibility
- Position to add large-scale offshore wind resource on line



# WindFloat Pacific – a Path to a Floating Future

"This is a really exciting and innovative project. It involves a floating technology that has enormous potential on the West Coast, where the shelf drops off steeply, as well as around the world."

**BOEM Director Tommy Beaudreau, DNCI Announcement Press Event, Portland OR, February 6, 2014.**

"I will say with regard to timing that we certainly feel a sense of urgency. We'll be working in concert to expedite this to the extent that we can."

**Secretary of Interior Sally Jewell, DNCI Announcement Press Event, Portland OR, February 6, 2014.**

# Back Up Slides

# The WindFloat in Portugal