PelaStar Floating Offshore Wind Foundations

*Engineering Challenges and Challenges for Engineers*

Pacific Northwest AIAA Technical Symposium

Jay Edgar, 1 November 2014
Beyond Consulting Engineering

- Proven Offshore Experience
- Applied Analytical Horsepower
- Unique Concepts, Practical Designs
- Internal R&D in Offshore Wind Energy
  Spin-out: PelaStar Technology

MV *Delta Mariner* – Delta IV Transport
Lake Coeur d’Alene - Floating Golf Green
Kentucky Locks - 4000 Ton Heavy Lift Catamaran

FLIP – Research Spar
SBX-1 – Sea-Based X-Band Radar
Offshore Wind – Untapped Potential

Sustainable · Secure · Clean ... and Affordable

Transformative Technology for Offshore Wind Energy
Tension Leg Technology

**Ideal for Floating Wind**

- Planar Motion
- Minimal Footprint
- Pier-side Integration

And ...

- Unstable Without Tendons

... an engineering challenge!
Industrialized Deployment

- Pier Side Integration and Commissioning
- Installation Barge Engaged
- Foundation Pressed to Barge
- Tow Out
- Transit to Site
- Tendons Installed To Preset Anchors
- Installation Complete
Moving to Commercial Offshore Wind Energy

- Advanced Analysis
  Develop, Validate, Verify

- Simplify Everything
  Case Study: Tendons

- Challenges
  For Engineers
Achieving Technology Readiness Level (TRL) 5

- Analytical Goals:
  Verify basis for Loads, Fatigue, and Motions

- PelaStar Model Suite:
  **Parametric Design Optimizer**
  - Geometry, Structure, and Mass Distribution

  **Component-level Finite Element Models**
  - Hull, Tower, and Tendon Characteristics

  **Time-domain Dynamic Model (OrcaFlex)**
  - Aero: body form drag coefficients
  - Hydro: rigid buoy elements (Morison’s Eq.)
  - Elastic: 1D segmented mass-bearing elements

- Physical Model Tests
  - Aero-Hydro Response
Physical Model Tests

1:50 Scale Model Testing – MARIN
Power Production Tests – Operating Conditions
Will be added

- 50 Year Storm Conditions
**TRL 5 – Achieved**

- Physical-Analytical Test Comparisons
  - Good correlation across test ranges

- Dominant Structural Response
  - Wave Induced Fatigue Loading

- Slack Tendon & Capsize Resistance
  - Five Arm Design Proven Excellent

- Future Work
  - Spinning Turbine Implementation
  - Active Turbine Pitch Control
  - Fully Couple NREL FAST aero model
Tendon Case Study

Caption

- Bullet
Politics, Financing, Supply Chain

Caption

- Bullet
Delivering *Transformative* Energy Technology
Sustainable · Secure · Clean · Affordable