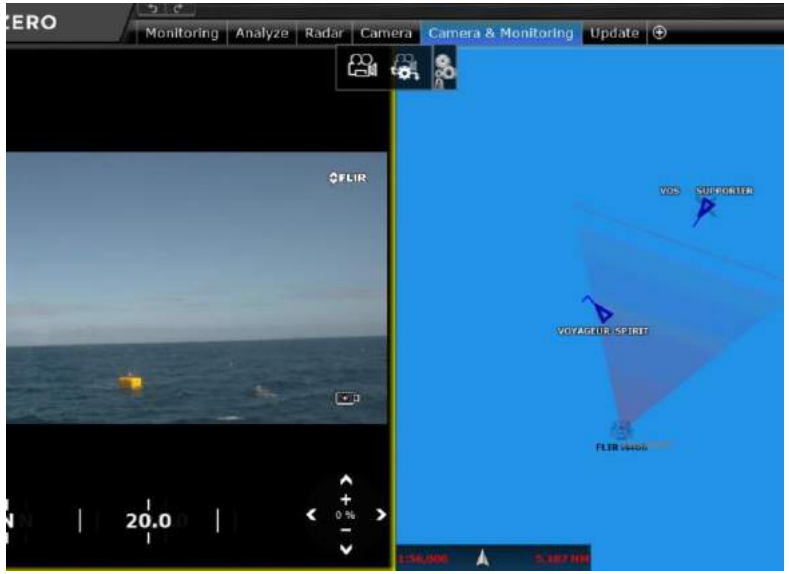
November 2019

OPT PB3 PowerBuoy® in the North Sea

Finalist in the 2019 OGUK Awards 'Energy Transition' Category



OPT
OCEAN POWER TECHNOLOGIES

PremierOil

The Challenge & OPT's PowerBuoy® Solution

THE CHALLENGE

- Premier Oil (Premier) have a lot of subsea wells to abandon and this will take many years to complete
- Campaign-based decommissioning across Premier's UKBU assets is preferred to maximise synergies and efficiencies
  - Includes well P&A activities with a dedicated single decommissioning drilling rig
  - Rig can only be on one asset at a time, prioritising (older) wells with known integrity issues

THE SOLUTION

- Ocean Power Technologies' (OPT) PB3 PowerBuoy® generates autonomous, renewable energy from wave motion and enables communication, data transfer, and remote operation (4G/VSAT)
  - Power subsea field equipment via a small umbilical
  - Exclusion Zone Monitoring™ with AIS, radar, real-time video, and alerts
  - Charging/communications hub for AUV applications
  - Environmentally-friendly and sustainable solution

THE PROJECT

- Demonstrate that OPT's PB3 PowerBuoy® can operate reliably as a clean power and communications hub in the notoriously harsh North Sea environment

Project Team

- **Client:**

PremierOil

- **Project consortium:**

OPT OCEAN POWER TECHNOLOGIES

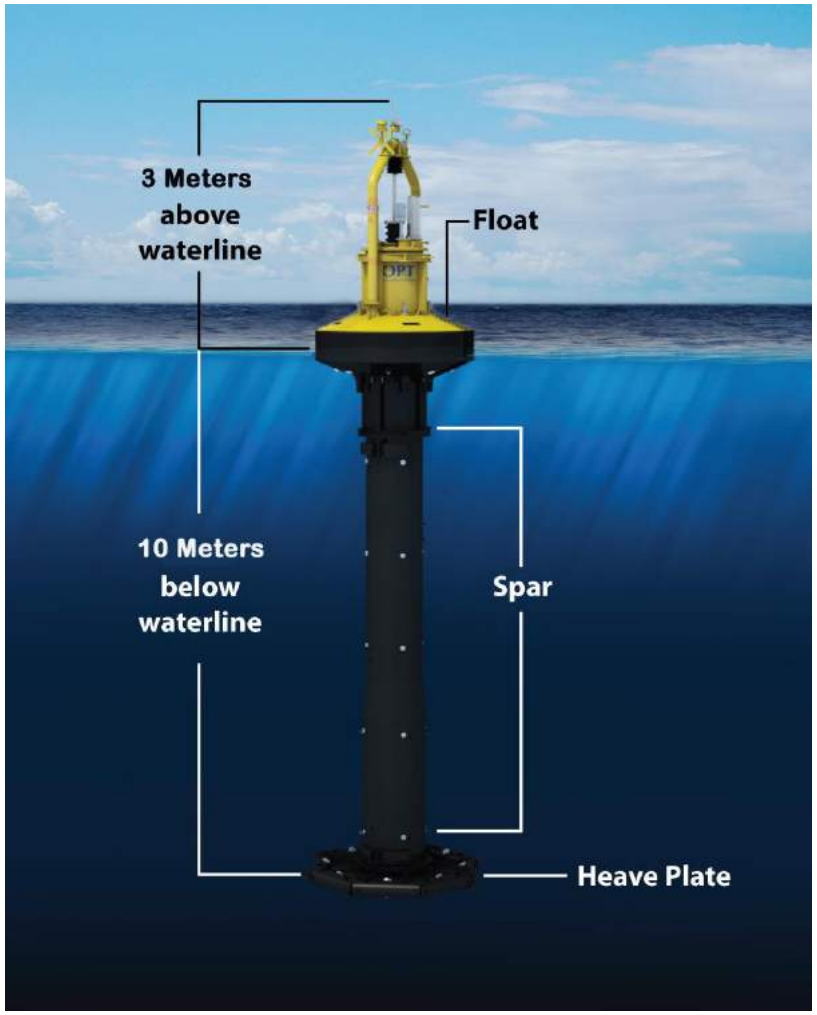
INTERMOOR PULSE tampnet

- **Project sponsor:**

The Oil & Gas Technology Centre
Your Innovation Partner

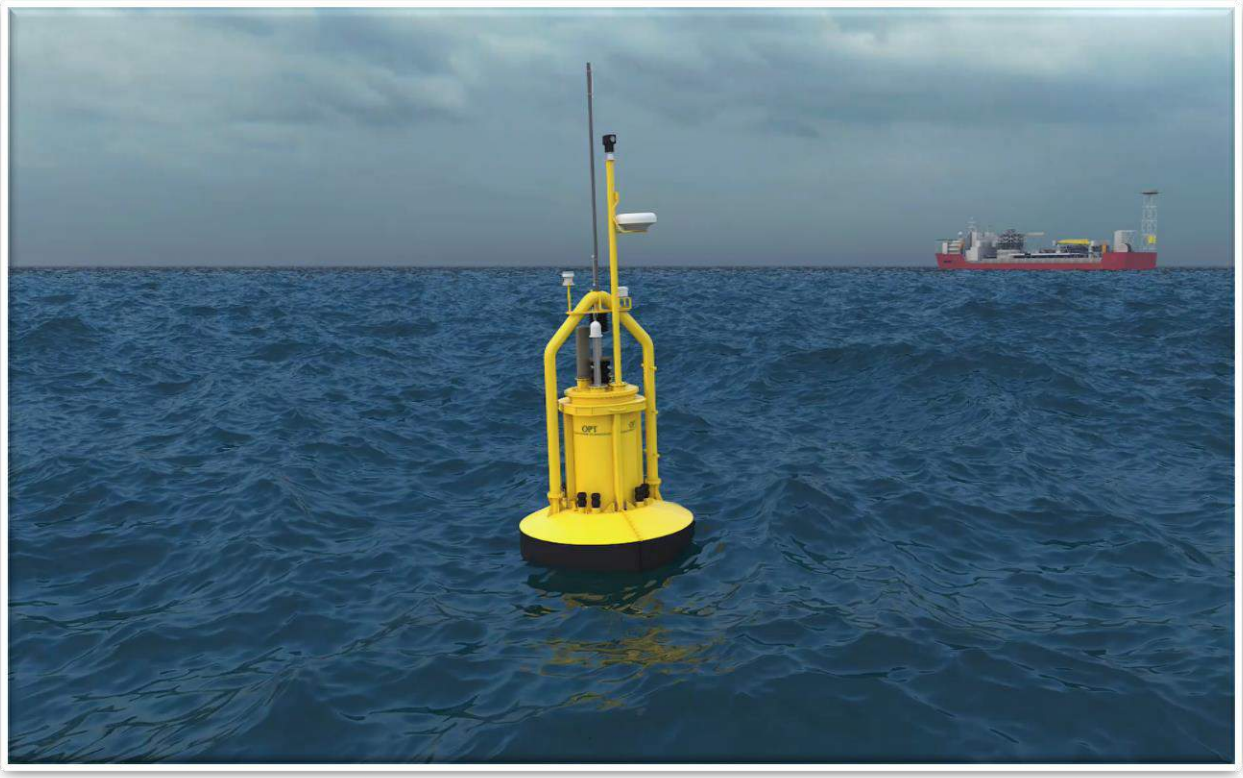
Introduction to the OPT PB3 PowerBuoy®

- Spar-design Wave Energy Converter (WEC) smart device, harvesting wave energy, which it converts into electricity and stores in batteries inside the hull
- Renewable power and communications platform which can be paired up with many different payload configurations
- Conforms to navigational requirements (markings, nav lights, etc.) set by the Northern Lighthouse Board (NLB)
- Designed and manufactured by U.S.-based Ocean Power Technologies (OPT)
- Deployed worldwide, including a 2011 test deployment in the Firth of Forth



PB3 PowerBuoy® - How it Works

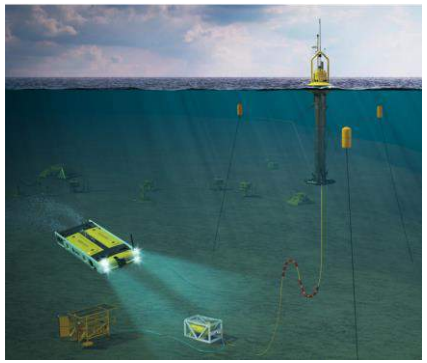
- OPT's PowerBuoy® is a moored floating mini-spar that generates power from ocean waves
- Power is generated through the relative motion of the spar and float components.
- Energy is stored in on-board batteries which can then be used to support topsides or subsea payloads
- A three-leg compliant mooring system controls the response of the buoy and allows it to remain on-station during storm events
- Power and data can be transmitted to/from the seabed through an umbilical



PB3 PowerBuoy® - Advantages

- **Better, Quicker Data** - Real-time data communications allows faster operational decision-making
- **Reduced Cost -** Financial savings by eliminating on-site support vessels
- **Reduced Risk & Increased Safety -** Remote operations from shore reduces personnel risk and increases personnel safety
- **Renewable Energy -** Decreased operational carbon footprint

PB3 PowerBuoy® - Applications



Monitoring:

- Exclusion Zone Monitoring™ implementation
- Subsea asset integrity
  - Providing real-time well and reservoir pressure, and temperature data

Power & Control:

- Enables AUVs & EROV residency
  - Docking station charging
  - Remote operation and control of residential IM&R and E&P
- Power to NUIs (normally unmanned installations)
- Enables remote, long-term metocean studies
- Power and control of subsea trees, local chemical injection skids and HPUs

PB3 PowerBuoy® - Applications

Mitsui Engineering & Shipbuilding – Kozushima Island (Sea of Japan)

- Deployment: April 2017 - *7 months in the water*
- First OPT Commercial Agreement
- Science/research sensor payload

Eni Residential AUV Configuration – Adriatic Sea

- Deployment: November 2018 – *mission ongoing*

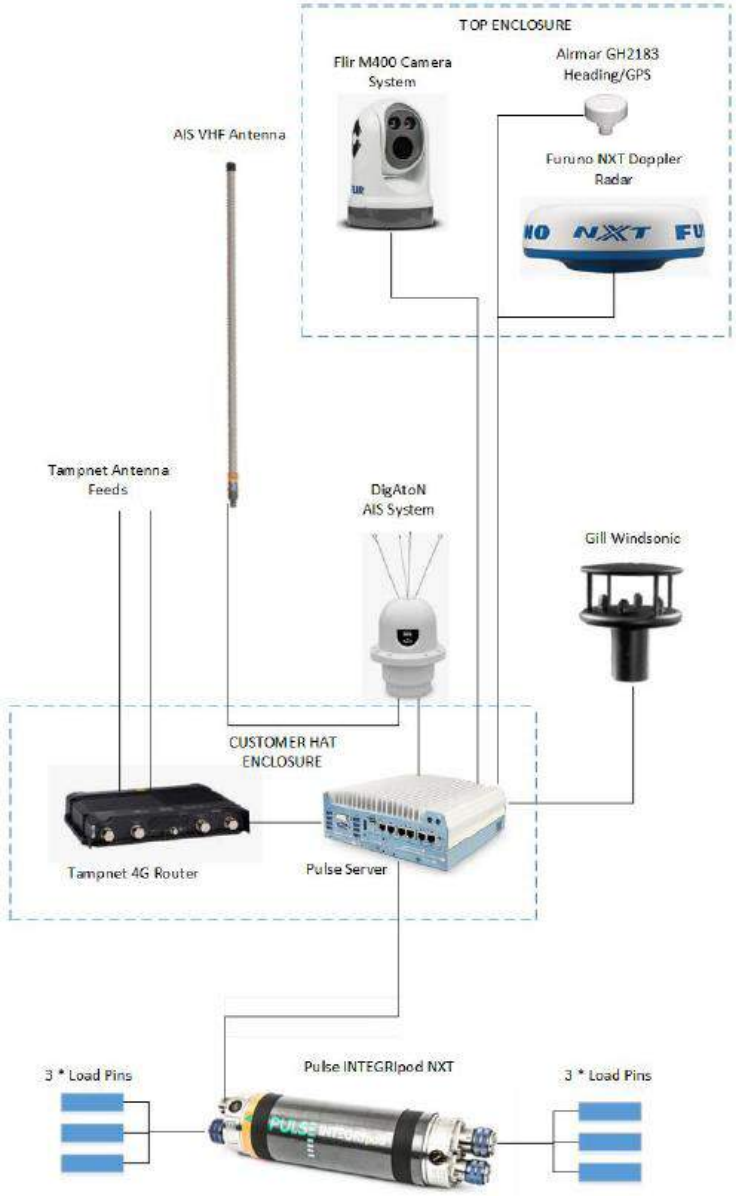
Fault free operation	> 1 year
Energy Created	1.6 MWh
PTO cycles	1,300,000
PTO distance travelled	2,098 km

Enel Green Power – MERIC Open Sea Lab Project Las Cruces, Chile

- Deployment: March/April 2020 – *four-year mission scheduled*
- Application: Environmental monitoring
- Equipment: Strain gauges, ADCP, water sensors, wave radar, power/data umbilical, communications

PB3 Demonstration Project Instrumentation

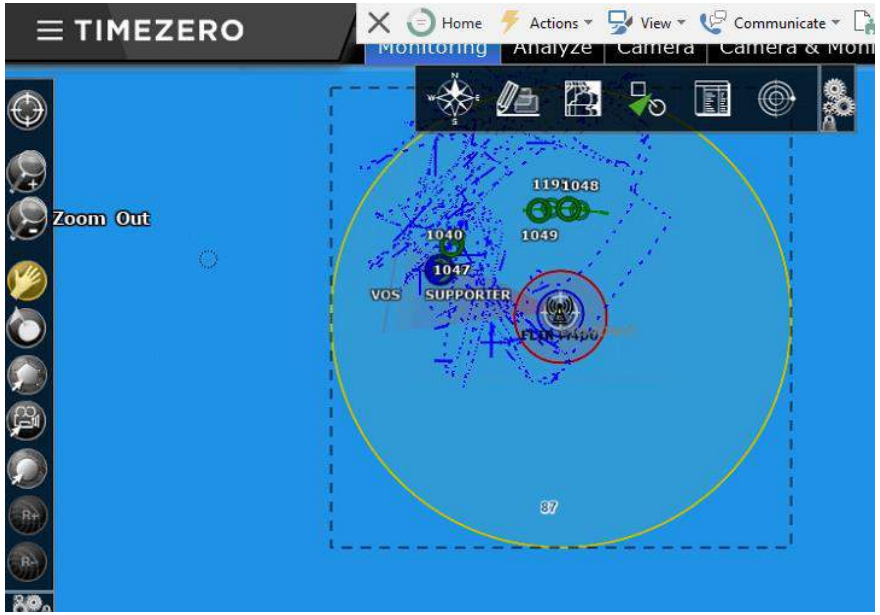
- Monitoring system
  - Mooring line monitoring (tension) and buoy motion monitoring using a Pulse INTEGRIpod
  - Environment monitoring using an AIS device transmitting the PB3 PowerBuoy® location to nearby AIS receivers, heading sensor, radar, camera, and on-board server running TIMEZERO software
- 4G wireless communications via Tampnet enabling 24/7/365 real-time data feed
  - Dedicated onshore workstation in Premier Oil offices in Aberdeen replicates the offshore TIMEZERO interface
  - Mooring line data relayed directly to Pulse
  - PB3 PowerBuoy® performance data relayed directly to OPT operations centre in New Jersey
- A second, fully independent GPS system transmits location data via satellite directly to the OPT operations centre in New Jersey

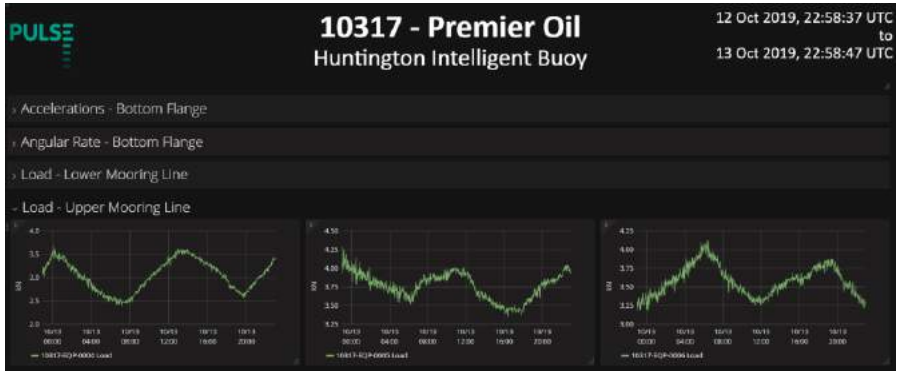


PB3 Demonstration Project at the Huntington Field

See video on YouTube: https://youtu.be/vNyBkDDMm6Q

PB3 Demonstration Project at the Huntington Field





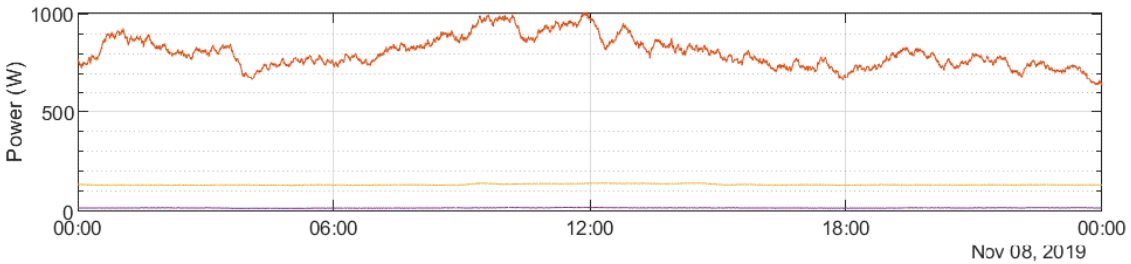


Figure 1: The PB3 generated electrical (red), payload (yellow), and dump (purple) powers; 30-minute moving averages

The PB3 PowerBuoy® - Summary

- PB3 PowerBuoy® is performing well to date
- Potential second phase would see the PB3 PowerBuoy® provide all the functionality of phase 1 AND connect to a legacy subsea control system via an umbilical to provide power and communications to and from subsea assets
- PB3 PowerBuoy® is an innovative, ocean-tested, proprietary autonomous system that converts wave motion into clean, reliable, and persistent electricity for offshore applications

- PB3 PowerBuoy® enables real-time operational control and long-term operational capabilities at minimum cost and with minimal carbon footprint
- PB3 PowerBuoy® can provide power and communications to enable:
  - Site/asset monitoring during decommissioning
  - Remote operation and control of subsea assets
  - Marine scientific research

November 2019

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