INTEGRATED TIDAL ENERGY

SUSTAINABLE MARINE ENERGY

POWERED BY SCHOTTEL HYDRO

Environmental Monitoring on PLAT-I

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Craig Chandler, Sustainable Marine Energy Ltd.

About Sustainable Marine Energy

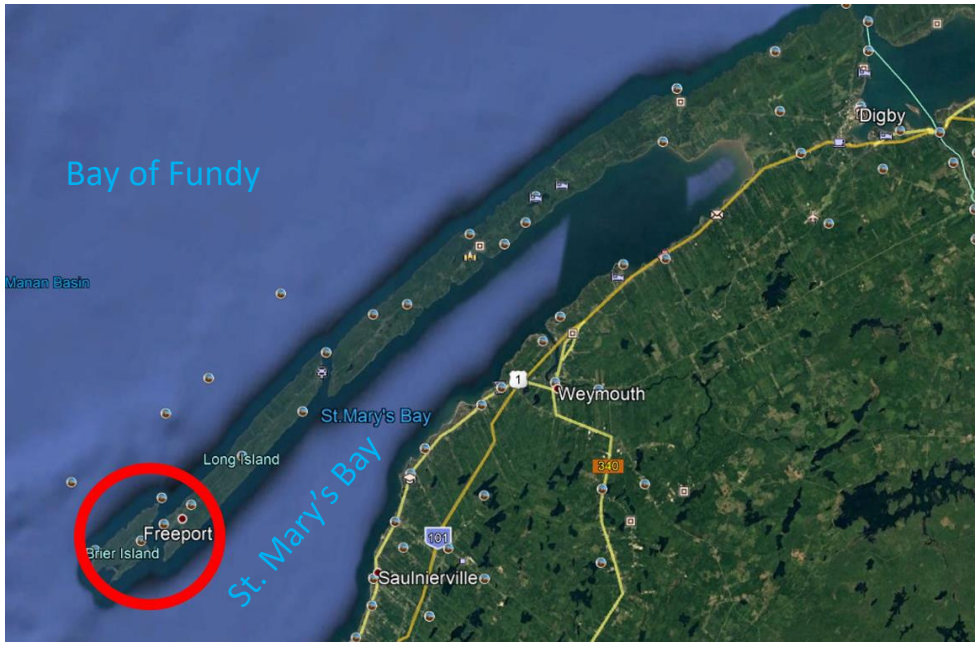
- Tidal Energy Technology Developer
- Founded in 2012
- SMEC's objective:

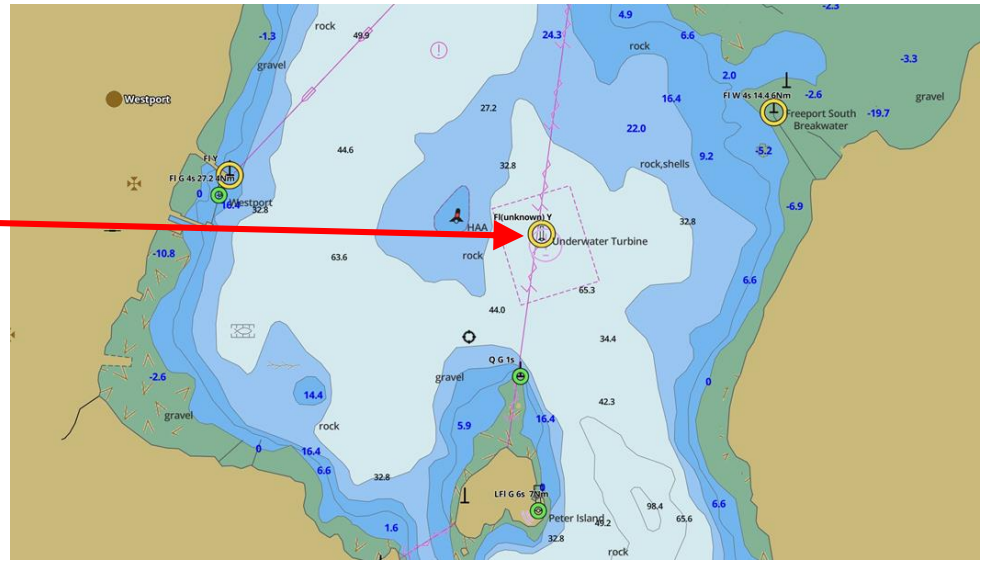
To develop tidal energy systems to provide island and coastal communities with a source of reliable, predictable and clean power

- Locations in Scotland, Germany and Canada
- Grand Passage demonstration is part of a stepwise development of technology
- Currently planning initial FORCE deployment

PHYSICAL CHARACTERISTICS

- Grand Passage joins St. Mary's Bay and outer Bay of Fundy
- Strong currents promote mixing, and scouring of the seabed
- Depths range from about 12m to 30m
- Maximum currents are ~6 knots (3m/s)
- Mean tidal range is 6.4m
- PLAT-I installed in main channel





HABITAT CHARACTERISTICS

- Grand Passage has significant marine animal diversity and abundance
- Not considered critical habitat for marine mammals
- Fish in Grand Passage are expected to be of the same species composition and abundance as in other areas of outer Bay of Fundy

Mammals
- Harbour porpoise
- Humpback whale
- North Atlantic Right whale
- Grey seal
- Harbour seal

Fish
- Herring
- Gaspereau
- Atlantic Salmon

Birds
- Double-crested Cormorant
- Great Cormorant
- Great Blue Heron
- Great Black-backed Gull
- Herring Gull

Turtles
- Leatherback sea turtles

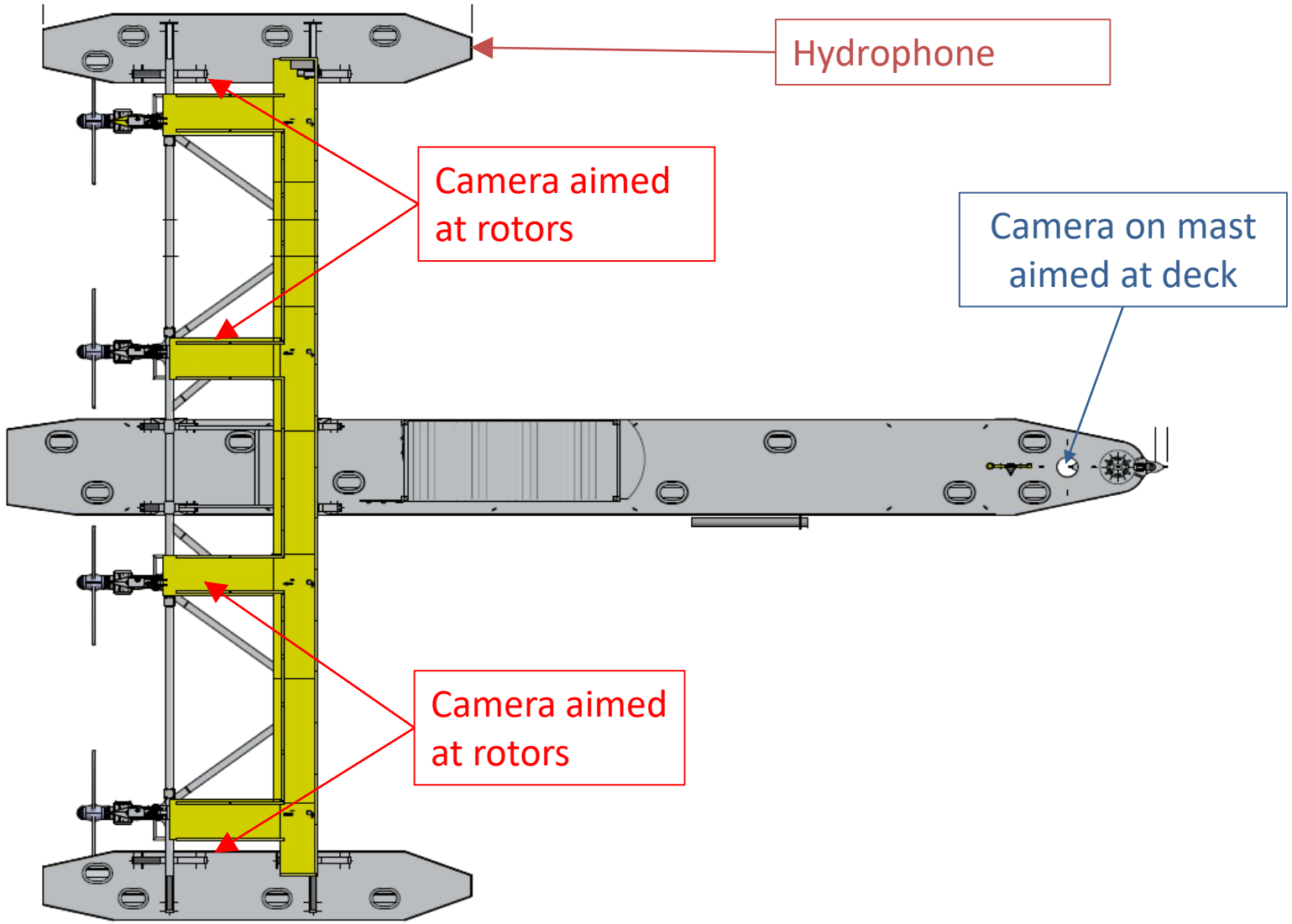
https://porpoise.org/about-porpoises/harbour-porpoise/

Objectives of Environmental Monitoring

- Observe near field of turbines to assess the presence, abundance and behaviour of fish, seabirds, sea turtles and marine mammals
- Collect data to better understand what animals are doing in wider area
- Further evaluate risk associated with potential interactions with marine life
- Identify development and data needs to help retire environmental risks
- Assess instrumentation for use in FORCE (higher turbidity, no optical cameras)

Environmental Monitoring

- Turbines only operated during daylight hours
- Visual marine animal monitoring every 30 minutes during turbine operation
- Four MacArtney LUXUS Compact PUR underwater video cameras
- Hydrophone data collection with OceanSonics icListen hydrophone
- Turbines stopped if Species at Risk or unidentified baleen whales <100m



VIDEO MONITORING

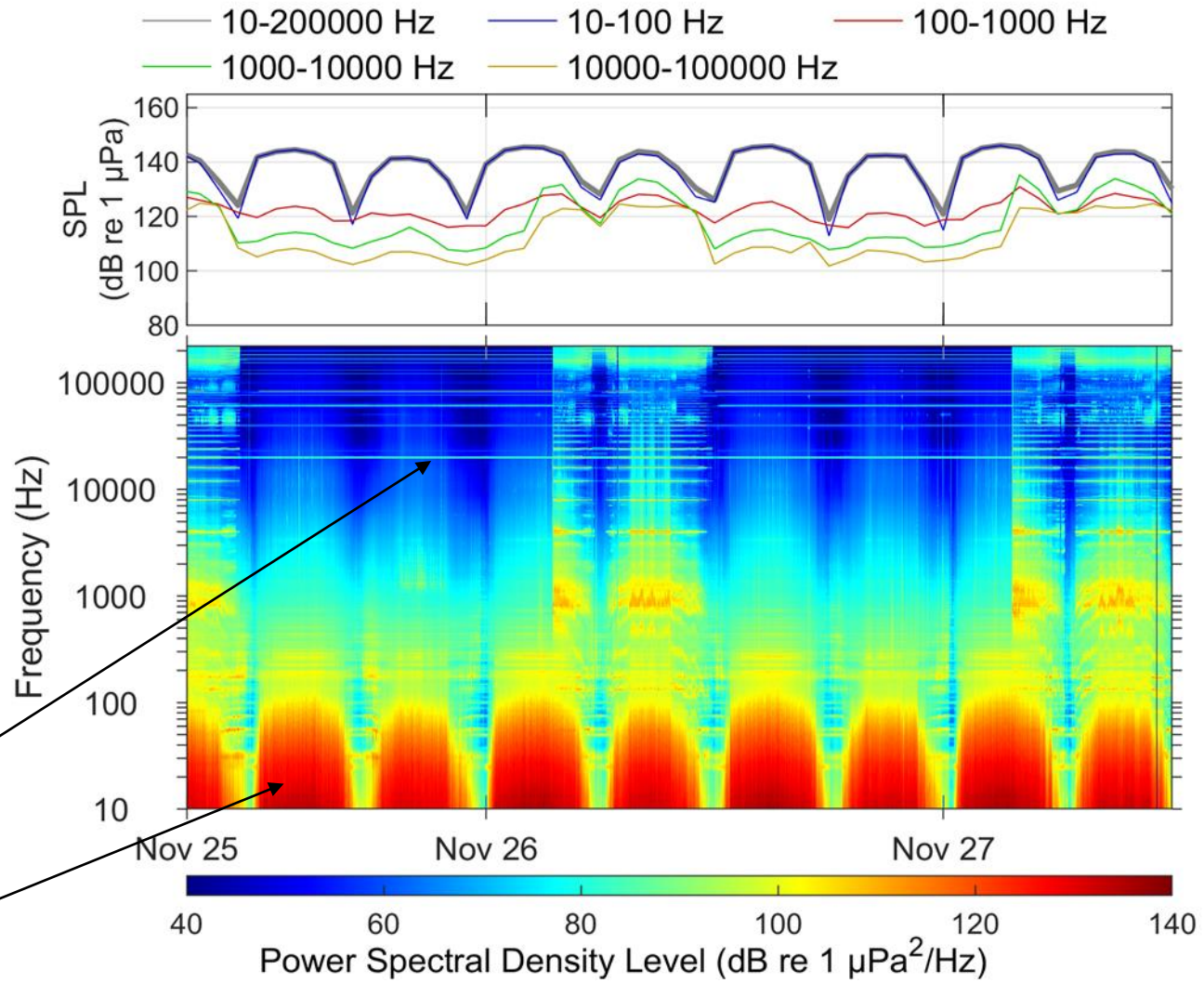
- Underwater video data reviewed and analyzed by Aquatera Ltd.
- Correlated with time of day, flow velocity and tide cycle
- Regulator found video quality appropriate and acceptable

VIDEO DATA RESULTS

- No marine animals observed except one fish and many jellyfish
- No contact between marine animals and turbines observed
- No other observations of animals near the turbines during operations
- Next steps are to test passive and active acoustics – necessary for FORCE

HYDROPHONE DATA RESULTS

- Analysis of underwater sound data by Jasco Applied Sciences
- Good quality data and useful for analysis
- Sound levels affected by turbulent flow around hydrophone and PLAT-I
- Flow noise greatly reduced by adjusting hydrophone location and orientation
- 20 kHz: on-board electrical interference (not sound in the water) possibly ‘picked up’ through the hydrophone power supply
- Operating turbines clear, but low levels of noise, especially compared to tidal cycle



HYDROPHONE DATA RESULTS

- Worst case measured sound levels are below sound levels for typical vessels expected in Grand Passage
- Moan and whistle detectors used to identify sounds from baleen whales and dolphins - manual review of 322 files did not identify any signals
- Automated analysis followed by manual validation of porpoise clicks: ~1 of 5 had valid harbour porpoise click detections - many false positives.
- Highly unlikely to injure porpoise even if they remained within one length of PLAT-I for an entire day
- Neither hearing injury nor significant behavioural disturbance of fish is expected based on the measured sound levels

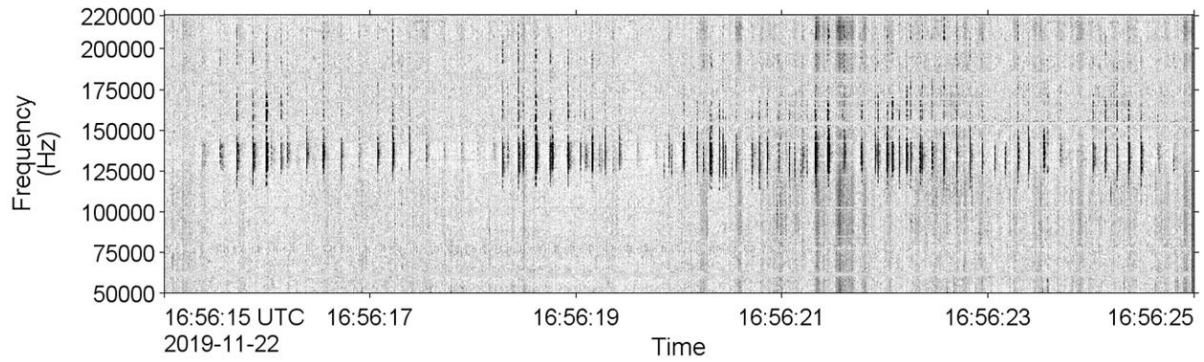


Figure 10. Spectrogram of a harbour porpoise click train recorded on 22 November 2019. (64 Hz frequency resolution, 0.01 s time window, 0.005 s time step, Hamming window). The window length is 10 s.

Figure 11. Daily and hourly harbour porpoise click detections (black: confirmed; grey: tentative) identified via manual validation between 4 November and 6 December 2019. The red dash bars show the deployment and retrieval dates.

Marine Animal Observation Results

- Marine Animal Observations conducted at 30-minute intervals during operation
- Observations recorded in data logs and stored electronically
- Third party review of methods and results by Envirosphere Consultants
- Only a few harbour porpoises, harbour seals and cormorants observed near platform during operations to date

Next Steps

- Continued operation of PLAT-I at Grand Passage
- Continued collection and analysis of environmental monitoring data
- Continued development of environmental monitoring system for FORCE
- Move to 24-hour operation
- Initial trials of second-generation device at FORCE demonstration site
- Data available to researchers; for example The Brydon Centre is used hydrophone data for biofouling research

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HYDROPHONE DATA RESULTS

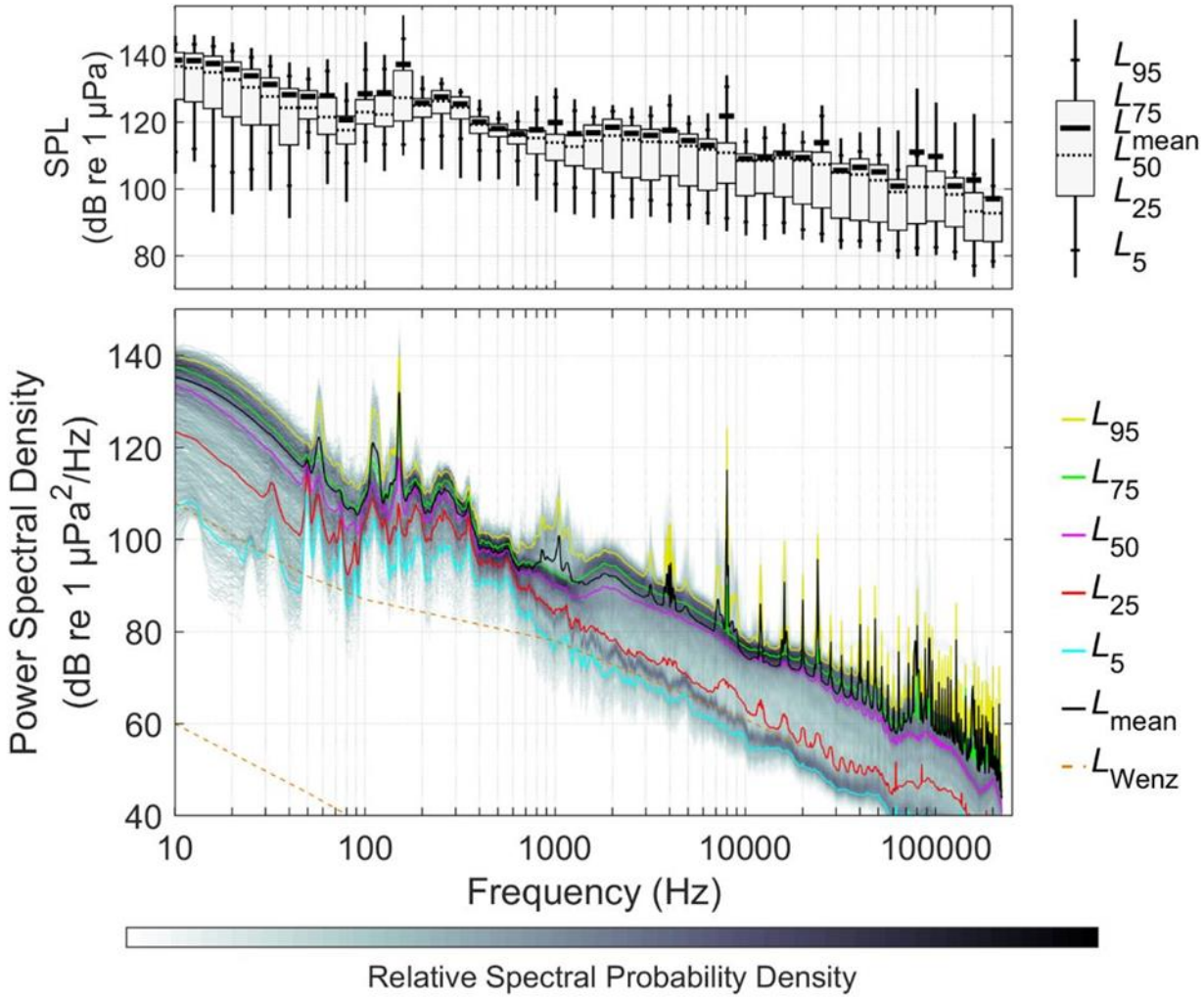

Figure 10. Bottom) Power spectral density levels and (top) distributions of decidecade sound pressure levels at from the PLAT-I hydrophone on 8-9 March 2019.