

Tidal Stream Energy Project:

# Collision Risk Data and Evidence Summary (2025)

FACT SHEETS

## 2.2.1 SeaGen Unit, Strangford Lough



Factor	SeaGen
Country	Northern Ireland, United Kingdom
Developer	Marine Current Turbines (MCT)
Project start date	December, 2008
Project status	Decommissioned
Project scale	Single device
Support structure/anchor type	Monopile supported by four pin piles
Technology	Surface piercing, bottom-mounted
Installed capacity	1.2MW
Physical site	Constricted channel, shallow channel (<40m), narrow channel (<2km), noisy environment (>80dB)
Water depth	24m
Marine mammals	<b>Monitoring focus:</b> harbour seal <b>Other species observed in the area:</b> harbour porpoise, grey seal, otter
Collision monitoring	Shore-based surveys, passive acoustic monitoring (T-PODs), carcass postmortems, aerial surveys, harbour seal telemetry, two 375 kHz manually-scanning sonar systems (Tritech Super SeaKing) sonar target detections
Other monitoring	Underwater noise monitoring, ADCP survey data
Seasonality of monitoring	<b>Shore-based marine mammal surveys:</b> May 2005 to December 2010 <b>Aerial surveys:</b> 2006 to 2010 <b>Harbour Seal Telemetry:</b> Pre-installation: April 2006 to July 2006 During installation and commissioning: March 2008 to July 2008 Operation: April 2010 to July 2010 <b>Passive Acoustic Monitoring (T-PODs):</b> 2006–2011 <b>Marine Mammal Carcass Monitoring:</b> Until September 2009

**Active Sonar:**

Started July 2008

**Underwater noise:**

23th April 2008 between 09:00 and 21:00 during drilling operations on the North-West foot of the SeaGen base

**Benthic ecology:**

Pre-installation: March 2008

Post installation surveys: July 2008, March 2009, July 2009 and April 2010

**Ornithology:**

April 2005 to March 2011

Number of collisions recorded

No collisions observed

Advantages and limitations of monitoring techniques (inclusive of but not limited to)

N/A

Main consenting concern

Marine mammals, benthic ecology, and tidal flow and energy

Licensing conditions

A detailed Environmental Monitoring Programme (EMP) and associated suite of mitigation measures were established as a condition of the FEPA Licence

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## 2.2.2 Shetland Tidal Array, Bluemull Sound



Factor	Shetland Tidal Array
Country	Scotland, United Kingdom
Developer	Nova Innovation
Project start date	March, 2016
Project status	In operation
Project scale	Array
Support structure/anchor type	Gravity foundation
Technology	Bottom-mounted
Installed capacity	0.3MW
Physical site	Constricted channel, shallow channel (<40m), narrow channel (<2km), noisy environment (>80dB), hard-bottom habitat
Water depth	30-40m
Marine mammals	<b>Monitoring focus:</b> harbour seal <b>Other species observed in the area:</b> grey seal, harbour porpoise, humpback whale, minke whale, Risso's dolphin, killer whale
Collision monitoring	Monthly land-based surveys and high-definition cameras on all turbines in the array
Other monitoring	Sound levels of turbines
Seasonality of monitoring	<b>Vantage Point Surveys:</b> Conducted over a nine-year period spanning November 2010 to October 2019. Surveys were split quarterly as follows: <ul style="list-style-type: none"> <li>• February to April</li> <li>• May to July</li> <li>• August to October</li> <li>• November to January.</li> </ul> <b>Subsea video monitoring:</b> Commenced in October 2015 it was stored and recorded over the period of all turbine installations until August 2017
Number of collisions recorded	No collisions observed

Advantages and limitations of monitoring techniques (inclusive of but not limited to)

**Advantages:**

Monthly land-based bird and mammal survey:

- Cost-effective and simple technique
- Provide information on presence, occupancy patterns and behaviour of animals in and around the project site to gain general insights into the potential for collision risk
- Enable better understanding for other potential impacts to species such as disturbance or displacement
- Allow for comparison between different project phases.

Subsea video monitoring:

- Cost-effective and simple subsea monitoring technique
- Provide information on presence, occupancy patterns and behaviour of animals around the turbines
- Enable better understanding for near-field encounters and collision risk.

**Limitations:**

Monthly land-based bird and mammal survey:

- Do not provide information on animals at turbine depth so data are not accurate for assessing collision risk
- Caution required in data analysis and interpretation (e.g. availability bias, influence of meteorological conditions and other wider factors affecting populations and individuals).

Subsea video monitoring:

- Only gathers useful data in daylight and good water clarity
- Generates huge quantities of data for analysis and storage
- Requires time-consuming manual analysis or development of AI tools
- As with any subsea sensor, biofouling can affect performance.

Main consenting concern

Harbour seal is the primary consenting constraint due to the declining status of the Northern Isles population. Collision Risk Model outputs in combination with other tidal developments affecting the same population (MeyGen, EMEC) exceed Potential Biological Removal (PBR) values for this population. Impacts on other marine mammals are also a concern. The key species of concern are all European Protected Species (EPS) (harbour porpoise, killer whale, Risso's dolphin, humpback whale, minke whale). Several bird species were also raised as concerns in consenting, due to proximity of various Special Protection Areas. The Appropriate Assessment (available on the Marine Scotland Interactive website) concluded no Likely Significant Effect (LSE)

## Licensing conditions

The main condition is 3.2.1.1 relating to the need for a Project Environmental Monitoring Plan (PEMP) and regular monitoring reporting. The wording of the condition itself isn't prescriptive about the nature of the monitoring. To ensure it was focused and had clearly defined objectives, Nova developed and agreed a PEMP scoping document with Marine Scotland Licensing and its advisors. Once the objectives were agreed it gave the monitoring clear purpose (detecting any collisions or near misses between marine mammals and diving birds and the turbines, and understanding their behaviour in the nearfield area around the turbines)

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## 2.2.3 MeyGen Tidal Energy Project, Inner Sound



Factor	MeyGen Tidal Energy Project
Country	Scotland, United Kingdom
Developer	SAE Renewables
Project start date, 1 <sup>st</sup> power	November, 2016
Project status	In operation
Project scale	Array
Support structure/anchor type	Gravity foundation
Technology	Bottom-mounted
Installed capacity	6MW
Physical site	Constricted channel, shallow channel (<50m), wide channel (>2km), hard-bottom habitat
Water depth	30-50m
Marine mammals	<b>Monitoring focus:</b> harbour seal, grey seal, harbour porpoise <b>Other species observed in area:</b> humpback whale, minke whale, Risso's dolphin, killer whale
Collision monitoring	GPS tags, Passive Acoustic Monitoring (PAM) using hydrophones, drifters, active sonar data, video recording
Other monitoring	Pre-consent bird survey
Seasonality of monitoring	<b>Seal GPS Traking:</b> GPS tags deployed on 40 harbour seals <ul style="list-style-type: none"> <li>• March to September 2011</li> <li>• September to October 2016</li> <li>• April 2017</li> <li>• April 2018.</li> </ul> <b>PAM:</b> PAM using hydrophones on Turbine Support Structure and drifters to detect cetacean and track movement. October 19, 2017 to September 22, 2018 (PAM system operational 322 days) then December 18, 2018 to October 15, 2019

**Multibeam Sonar:**

Over 12 months of active sonar data collected June 2022 to July 2023. Located 32m at right angles to the main flow, the sonar painted the entire structure from seabed upwards

**Underwater operational sound:**

Acoustic baseline surveys before turbine installation were carried out on October 1, 2015, May 24, 2016, June 23, 2016, June 24 2016. The acoustic survey of the Atlantis AR1500 turbine was carried out on August 6, 2018

Number of collisions recorded

No collisions observed

Advantages and limitations of monitoring techniques (inclusive of but not limited to)

**Advantages:**

Fine scale interactions have been obtained using:

- passive acoustic techniques for echolocating cetaceans
- active sonar to provide a side view of rotor encounters
- video cameras with limited field of vision due to technology available at the time and the size of the rotor.

All of these methods provided an insight into fine scale interaction of marine species with the turbine rotor and foundation.

Each method addresses a different form of assessment and unfortunately, they were not all active at the same time

**Limitations:**

A data set providing a continual record of fine scale interaction is needed, and while each of the above data sets provide valuable input to collision risk modelling, a concurrent data set would have provided a greater level of certainty as to the level of species avoidance and risk of collision

Main consenting concern

Collisions between marine mammals and installation vessels, collisions between marine mammals and the devices, and disturbance to fish due to EMFs from subsea cables

Licensing conditions

N/A

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## 2.2.4 European Marine Energy Centre (EMEC) Fall of Warness grid-connected tidal test site



Factor	Orbital Marine Power O2 at EMEC	Magallanes Renovables ATIR at EMEC
Country	Scotland, United Kingdom	Scotland, United Kingdom
Developer	Orbital Marine Power	Magallanes Renovables
Project start date	April, 2021	February, 2019
Project status	In operation	In operation
Project scale	Single device	Single device
Support structure/anchor type	Mooring lines, gravity anchors	Mooring lines, gravity anchor
Technology	Floating	Floating
Installed capacity	2MW	1.5MW
Physical site	Open coast, constricted channel, isolated/quiet environment (<80dB), hard-bottom habitat	Open coast, isolated/quiet environment (<80dB), hard-bottom habitat
Water depth	12-50m	
Marine mammals	<p><b>Monitoring focus:</b> harbour seal, grey seal and harbour porpoise</p> <p><b>Other species observed in area:</b> minke whale, Risso's dolphin, humpback whale, sperm whale, killer whale, common dolphin, bottlenose dolphin, Atlantic white-sided dolphin, white-beaked dolphin</p>	
Collision monitoring	Surface cameras, underwater cameras and preparing for active acoustics	
Other monitoring	Bird and marine mammal observations (2023-2025)	

<p>Seasonality of monitoring</p>	<p><b>Vantage Point surveys:</b> Conducted daily from July 2005 to 2011. 4hrs a day 5 days a week across winter, spring, summer and Autumn</p> <p><b>Video monitoring:</b> Between June and July 2009 and June 2010</p> <p><b>Hydrophone:</b> The study was carried out on the September 20, 2011, using Drifting Ears equipment, and 23 and 26 of March, 2012, using Drifting Acoustic Recorded and Tracker (DART) equipment</p> <p><b>Sonar:</b> FLOWBEC frame deployed twice in summer 2013</p>	
<p>Number of collisions recorded</p>	<p>No collisions observed</p>	
<p>Advantages and limitations of monitoring techniques (inclusive of but not limited to)</p>	<p><b>Disadvantages:</b> Battery life on video monitoring and acoustic data unless power source available</p> <p>Very high energy environment to deploy/recover equipment and maintain</p>	
<p>Main consenting concern</p>	<p>Acoustic disturbance due to increase vessel presence onsite, installation and maintenance work and the direct acoustic output from the turbine during operation</p> <p>Risk of entanglement of marine megafauna with the mooring system and dynamic cable</p> <p>Displacement and disturbance to species in the immediate vicinity</p> <p>Seabed clearance including impact to benthos</p> <p>Biofouling and introduction of non-native species during towing operations</p> <p>Collision risk of marine megafauna with the moving parts of the device</p>	<p>Disturbance and/or displacement due to the presence and operation of the ATIR and associated vessels</p> <p>Disturbance from the acoustic output from the operational ATIR and vessels associated with installation, maintenance and decommissioning</p> <p>Risk of interaction/collision with the turbines installed on the ATIR</p> <p>Risk of entanglement or entrapment with the mooring system for the ATIR</p> <p>Disturbance from breeding/migratory routes through electromagnetic interference</p> <p>Biofouling and introduction of non-native species</p> <p>Pollution from accidental discharges</p>
<p>Licensing conditions</p>	<p>Collision risk modelling</p> <p>Device acoustic characterisation</p>	<p>Collision risk modelling</p> <p>Device acoustic characterisation</p>

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## 2.2.5 Morlais Demonstration Zone



Factor	Morlais Demonstration Zone
Country	Wales, United Kingdom
Developer	Menter Môn
Project start date	December, 2021
Project status	Pre-construction
Project scale	Test site
Support structure/anchor type	Multiple (Monopile, gravity foundation, mooring lines, gravity anchor, drag embedment anchor, rock anchor)
Technology	Multiple (Bottom-Mounted, Suspended in Water Column, Floating)
Installed capacity	Up to 240MW
Physical site	Isolated/quiet environment (<80dB), soft-bottom habitat, hard-bottom habitat
Water depth	40m
Marine mammals	<p><b>Monitoring focus:</b> harbour porpoise, grey seal, bottlenose dolphin, common dolphin, Risso's dolphin, minke whale</p> <p><b>Other species observed in area:</b> harbour porpoise, common dolphin, Risso's dolphin and bottlenose dolphin</p>
Collision monitoring	As this test site is in pre-construction, no collision monitoring has been performed to date. Monitoring at Morlais include soundtrap recorders, hydrophones, PAM, towed PAM, subsea cameras, land-based vantage point surveys, GPS/GSM tagging, underwater noise monitoring, boat based surveys, drones (+technology testing)
Other monitoring	Sonar, boat based technology deployment
Seasonality of monitoring	<p><b>Soundtrap (15 static PAM units):</b> December 2022 to November 2023 - 12 months continuous deployment</p> <p><b>Bottom and surface mounted Hydrophones:</b> November 29, 2022 to July 25, 2023 - four field trips collected 139 hours of drifting array data</p> <p><b>Surface and subsea cameras:</b> June, 2023 to March, 2024</p>

**Land based vantage point surveys:**

May 2022 to September 2022

**Bird tagging:**

June 2022 and June 2023

**Colony counts:**

April 1, 2022 to July 15, 2022 and April 1, 2023 to July 15, 2023

**Underwater noise modelling:**

February 11, 2023 to February 12, 2023

**Boat based surveys:**

April 2022 to March 2024

**Drones:**

March 2023 to September 2023

**Towed 3D PAM:**

November 29, 2022 to July 25, 2023

**Seal tagging:**

July 2023 to March 2024

**Sonar:**

12 months

**Boat based technology:**

June 1, 2023 to September 12, 2023

Number of collisions recorded

N/A

Advantages and limitations of monitoring techniques (inclusive of but not limited to)

**Advantages:**

Boat based surveys, colony counts, tagging (seal and bird) and underwater noise monitoring are tried and tested survey methodologies. This reduces the likelihood of difficulties with the techniques. The data analysis is relatively standard and therefore not complex

The EMMP intergrated monitoring system is expected to allow deployment of tidal stream devices in very sensitive areas, whilst effectively managing any potential risk of collision

**Limitations:**

As with all data collection, the volume of data that is collected, then has to be stored. This is particularly relevant with the sound trap data - 12 months worth of data from 15 sound traps was collected. This all needs to be processed as well as stored. The processing time is human time hungry

Limitations of the subsurface cameras is the visibility on site

Weather on site - e.g. preventing boat based surveys

Vantage point surveys - the limitation of these surveys was that it was not possible to clearly see the MDZ from the cliff, therefore removing any benefit of these surveys

The number of experts in some of the fields (i.e. seal tagging) is small, therefore reducing options

The main limitation of the mitigation system is that this is not an off the shelf system. It is being developed as part of the project as no such mitigation system is commercially available. As the system is being developed, and this development involves the training of AI systems to identify objects seen on sonar imagery, this takes time. There are also setbacks when developments do not go according to plan

#### Main consenting concern

The ES produced in relation to the original application identified potentially significant effects upon some marine mammal and diving seabird species, particularly through collision with operational TECs and displacement if the Project was to be deployed to maximum installed capacity without mitigation measures

Underwater noise from operational turbines and any acoustic deterrent devices (ADDs) used will not result in the significant disturbance of marine mammals (harbour porpoise) in the North Anglesey Marine/Gogledd Môn Forol SAC

Visual impact is also a major consideration at the site given its proximity to the Area of Outstanding Natural Beauty (AONB)

#### Licensing conditions

There are many conditions, however the most relevant are:

Requirement for the development and implementation of an EMMP (Environmental Mitigation and Monitoring Plan)

Requirement for the development and implementation of a MMMP (Marine Mammal Mitigation Plan) for any construction activities

Species specific marine mammal collision limits:

Harbour porpoise: 3 per year

Grey seal: 5 per year

Bottlenose dolphin: 2 over 3 years

Common dolphin: 5 per year

Risso's dolphin: 1 per year

Minke whale: 1 per year

All other cetaceans: 1 per year

Confirmatory visual impact assessments required before array deployments to allow consent with a wide range of possible technologies under the Project Design Envelope approach

Confirmatory Navigation Risk Assessments required before array deployments to allow consent with a wide range of possible technologies under the Project Design Envelope approach

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## 2.3.1 France



Factor	D10 Tidal Turbine
Country	France
Developer	Previously Sabella, now Inyanga (Oct 2024)
Project start date	June, 2015
Project status	In operation
Project scale	Single device
Support structure/anchor type	Gravity foundation, gravity anchor
Technology	Bottom-mounted
Installed capacity	1MW
Physical site	Open coast, hard-bottom habitat, noisy environment (>80dB)
Water depth	55m
Marine mammals	<b>Observed in the area:</b> harbour porpoise, Atlantic bottlenose dolphin, common dolphin, striped dolphin, long-finned pilot whale, Risso's dolphin, grey seal
Collision monitoring	Video cameras, hydrophones, C-PODS, surface measurements
Other monitoring	ACDPs, biofouling
Seasonality of monitoring	<p><b>Underwater video monitoring:</b> October 2018 to April 2019 and April to September 2022. Monitoring in 2022 stopped because of biofouling on the camera. Data collected not analysed by Sabella</p> <p><b>C-Pod data:</b> June 2021 to January 2022 (no turbine immersed). C-POD data summer 2022 (with turbine), data not analysed by Sabella</p>
Number of collisions recorded	No collisions observed
Advantages and limitations of monitoring techniques (inclusive of but not limited to)	<p><b>Advantages:</b> Camera on the turbine allowing live acquisition of the data. C-Pods able to record independently and very reliable</p> <p><b>Limitations:</b> Biofouling on camera that occasionally needs to be cleaned. Analysis of the videos very time-consuming and tedious (no automatic software). Lots of problems with the instruments not located on the turbine (ADCPs, cameras on separate structures, etc.). Standard hydrophone not relevant</p>

Main consenting concern

Biofouling, interactions with fishes (collision), acoustic (mammals), impact on sediment transportation (addressed by numerical modelling). More recently, cable electromagnetism and impacts of coatings and anodes

Licensing conditions

Report on environmental monitoring to be transmitted every semester

Following monitoring required: acoustic (acoustic environment, marine mammals; equipment must be able to identify species), current, video (interferences fauna/turbine), analysis of species close to the demonstrator and collision risk, diving birds, biomass (biofouling)

This was determined following the Environmental Impact Assessment carried out as part of the permitting process

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## 2.3.2 Canada



Factor	Fundy Ocean Research Centre for Energy (FORCE)
Country	Canada
Developer	Fundy Ocean Research Center for Energy
Project start date	September, 2009
Project status	In operation
Project scale	Test site
Support structure/anchor type	Rock-bolt anchors, gravity foundations and gravity anchors
Technology	Bottom-mounted and floating tidal devices
Installed capacity	Up to 30MW
Physical site	Constricted channel, deep channel (>40m), wide channel (>2km), noisy environment (>80dB), hard-bottom habitat
Water depth	45m
Marine mammals observed	<b>Observed in area:</b> harbour porpoise, harbour seal, minke whale, sei whale, fin whale, North Atlantic right whale
Collision monitoring	C-POD, acoustic telemetry
Other monitoring	Lobster - Before/After, Control/Impact (BACI) study design using modified commercial traps Fish - Hydroacoustic surveys Seabirds - Observation-based surveys Marine sound - drifting and stationary hydrophone deployments
Seasonality of monitoring	Program dependent, but largely continuous between May 2011 and May 2018; intermittent thereafter based on requirements <b>Lobster catchability surveys:</b> Two surveys conducted in the fall of 2009 (before and after turbined deployment). One survey in spring of 2010 Baseline lobster catchability survey conducted over 11 days in 2017 582 lobsters tagged and released in fall 2021. Phase 1: August 29, 2021 to September 2, 2021. Phase: September 27, 2021 to October 1, 2021 <b>Fish hydroacoustic surveys:</b> Three 24-hour surveys pre-deployment (May, August, October 2016) and four 24-hour surveys during operation (November 2016, January, March, May 2017). Additional surveys after removal of Cape Sharp turbine (July, August, November 2017)

	<p><b>Marine sound:</b> Deployment of drifting hydrophone in October 2016 and March 2017</p> <p><b>Marine Mammals:</b> 2011 to 2020: Continuous passive acoustic monitoring (PAM) using C-PODs</p>
Number of collisions recorded	N/A - operational devices not deployed for long enough to assess collisions
Advantages and limitations of monitoring techniques (inclusive of but not limited to)	<p><b>Limitations:</b> High flow conditions place limitations on monitoring instrument performance generally</p> <p>Surveys using active acoustic devices are impacted by entrained air due to turbulence associated with tidal flows</p> <p>Minas Passage is a noisy environment, and the detection buffer of CPODs quickly becomes saturated with flow noise at high current speeds leading to lost monitoring time</p>
Main consenting concern	Collision risk with fish - particularly those afforded protection under Canada's Species at Risk Act, but also those of commercial and recreational value and those of cultural relevance to Indigenous communities
Licensing conditions	Specifics around monitoring requirements are being determined under a 'revised staged approach' to tidal project permitting proposed by DFO that stems from the final report of the <u><a href="#">Tidal Task Force on Sustainable Tidal Energy Development in the Bay of Fundy</a></u>

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## 2.3.2 Canada



Factor	PLAT-I 4.63	PLAT-I 6.40
Country	Canada	Canada
Developer	Sustainable Marine Energy	Sustainable Marine Energy
Project start date	September, 2018	May, 2022
Project status	Decommissioned	Ended April 2023
Project scale	Single device	Single device
Support structure/anchor type	Mooring line, Drag embedment anchor	Mooring line, Drag embedment anchor
Technology	Floating	Floating
Installed capacity	0.28MW	0.42MW
Physical site	Constricted channel, shallow channel (<40m), narrow channel (<2km)	Constricted channel, shallow channel (<40m), narrow channel (<2km)
Water depth	14m	14m
Marine mammals	<b>Observed in the area:</b> harbour porpoise, dolphin, grey seal, harbour seal	<b>Observed in the area:</b> harbour porpoise, dolphin, grey seal, harbour seal
Collision monitoring	Hydrophone, underwater cameras, visual marine animal observations	Hydrophone, underwater cameras, visual marine animal observations
Other monitoring	VEMCO Tag detector	VEMCO Tag detector
Seasonality of monitoring	<b>Video monitoring:</b> Recorded continuously through operating periods, which occurred intermittently between February 2019 to February 2020. Operatings were limited to daylight hours  <b>Visual marine animal monitoring:</b> Every 30 minutes during turbines operation	<b>Video monitoring:</b> Recorded continuously through operating periods May to November 2022. Operatings were limited to daylight hours  <b>Visual marine animal monitoring:</b> Every 30 minutes during turbines operation
Number of collisions recorded	No collisions observed	No collisions observed

<p>Advantages and limitations of monitoring techniques (inclusive of but not limited to)</p>	<p><b>Advantage:</b> Underwater video monitoring can provide species identification, and therefore allow for species-specific analysis, and the recording of specific behaviours such as fish shoaling, avoidance and collision with turbines</p> <p><b>Limitations:</b> Video only effective during daylight hours and hydrophone only provides present (positive) indication of 1 or more individual porpoise or dolphin</p>	<p><b>Advantage:</b> Underwater video monitoring can provide species identification, and therefore allow for species-specific analysis, and the recording of specific behaviours such as fish shoaling, avoidance and collision with turbines</p> <p><b>Limitations:</b> Video only effective during daylight hours and hydrophone only provides present (positive) indication of 1 or more individual porpoise or dolphin</p>
<p>Main consenting concern</p>	<p>Fish</p>	<p>Fish</p>
<p>Licensing conditions</p>	<p>Hydrophone and underwater video monitoring; intermittent marine life visual observation; daylight-only operation; cease operations if Species at Risk sighted within 100m; quarterly reporting</p>	<p>Hydrophone and underwater video monitoring; daylight-only operation; cease operations if Species at Risk or whale sighted within 100m; quarterly reporting</p>

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## 2.3.4 United States of America



Factor	Roosevelt Island Tidal Energy (RITE) Project Pilot
Country	United States of America
Developer	Verdant Power LLC
Project start date	January, 2012
Project status	Decommissioned
Project scale	Array
Support structure/anchor type	Gravity foundation
Technology	Bottom-mounted
Installed capacity	1.05MW
Physical site	Constricted river channel, noisy environment
Water depth	10m
Marine mammals	There were no resident marine mammals in the area
Collision monitoring	Dual-Frequency Identification Sonar (DIDSON), hydrophones, tagged species detection
Other monitoring	Seasonal species characterisation netting
Seasonality of monitoring	<p><b>DIDSON:</b> Seasonal three-week observation in close proximity to turbine system</p> <p><b>Underwater noise:</b> One month and two weeks underwater sound monitoring of operating turbines</p>
Number of collisions recorded	No collisions observed
Advantages and limitations of monitoring techniques (inclusive of but not limited to)	<p><b>Advantages:</b> Tag species detection was the most viable monitoring technique. Leveraging fish tagging campaigns conducted by researchers across the Eastern Seaboard, the deployment of inexpensive, robust acoustic tag detectors in and around the RITE Site enabled the collection of valuable long-duration species data at a reasonable cost</p>

Acoustic monitoring following IEC TS 62600-40 was a very viable monitoring technique as the standard gave clear guidance regarding methods and equipment and the regulators had confidence in the approach as it was based on an international, consensus-based standard

**Limitations:**

Netting was the least viable technique for species characterisation as netting in high current regions is very difficult and proved nearly useless

The use of high-resolution acoustic cameras was partially viable if deployed for short durations in close proximity to operating turbines

Main consenting concern

Fish and diving birds were the main consenting concerns. For fish, the main concerns were the endangered/threatened sturgeon species (including the Atlantic sturgeon and short-nosed sturgeon). An additional species of interest was the striped bass. For diving birds, the main species of interest was the cormorant

Licensing conditions

For the environment, there were 6 RITE Monitoring of Environmental Effects (RMEE) protocols that were implemented as well as an additional requirement for recreational usage monitoring. Verdant Power utilised a Risk Management Framework to help quantify the risks and to provide clear evidence of risk mitigation strategies

The license was granted under an Adaptive Management Framework and over time, environmental monitoring requirements were removed or reduced based on the reduction of perceived risk based on data acquired, processed and interpreted. For example, the RMEE for netting (RMEE-3) was closed due to the lack of efficacy of netting in the East River. Further, Verdant Power had a presence in the East Channel, East River for more than 15 years (and multi-year data collection in the West Channel as well) and the vast amount of data collected facilitated a meaningful understanding of the complex ecosystem and enabled the effective use of targeted monitoring equipment at specific flow-scales to answer specific questions/concerns that the regulators had

The development of a probabilistic fish-turbine interaction model that was validated with in situ data collection was a very valuable tool to highlight the low risk of fish-turbine interactions at the RITE Site

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## 2.3.4 United States of America



Factor	Cobscook Bay Tidal Energy Test Site
Country	United States of America
Developer	Ocean Renewable Power Company (ORPC)
Project start date	September, 2012
Project status	In operation
Project scale	Test site
Support structure/anchor type	Multiple (mooring lines, drag embedment anchor)
Technology	Multiple (bottom-mounted, suspended in water column)
Installed capacity	2012 TidGen® Power System: 150 kW
Physical site	Enclosed basin, noisy environment (>80 dB), soft-bottom habitat, hard-bottom habitat
Water depth	18-45m
Marine mammals	<p><b>Monitoring focus:</b> harbour seal, grey seal, harbour porpoise, Atlantic white-sided dolphin</p> <p><b>Other species observed in area:</b> fin whales, minke whale, North Atlantic right whale</p>
Collision monitoring	Visual observations and hydroacoustic monitoring data (echosounder)
Other monitoring	Acoustic monitoring of the device, drop down video cameras, biofouling assessment
Seasonality of monitoring	<p><b>Fisheries Monitoring Plan:</b> January and March</p> <p><b>Marine Mammal Observations:</b> In Cobscook Bay and Western Passage between December 2007 and December 2010</p> <p><b>Hydroacoustic monitoring from echosounder:</b> October 1, 2012 to October 5, 2012</p>
Number of collisions recorded	No collisions observed

Advantages and limitations of monitoring techniques (inclusive of but not limited to)	Method involved observing for individuals at the surface, so there is a key limitation that underwater collisions may not have been possible to detect
Main consenting concern	There are multiple threatened or endangered species with potential to occur in the Cobscook Bay test site area, including the Shortnose Sturgeon
Licensing conditions	Feasibility studies, including environmental monitoring surveys, and pre-filing consultation were conducted, resulting in ORPC's filing of a draft pilot project license application with FERC on July 24, 2009. The final pilot project license application was filed on September 1, 2011

\*The details included in each fact sheet depend on the availability and reliability of data from third-party sources as well as contributions and opinions from some industry stakeholders. Licensing conditions mentioned are the original conditions that were placed in the EMP at the time of consent

## 2.3.4 United States of America



Factor	RivGen®
Country	United States of America
Developer	Ocean Renewable Power Company (ORPC)
Project start date	January, 2019
Project status	In operation
Project scale	Array
Support structure/anchor type	Mooring line and drag embedment anchor
Technology	Floating
Installed capacity	0.07MW
Physical site	River, isolated/quiet environment (<80 dB), soft bottom habitat
Water depth	5m
Marine mammals/fish	<p><b>Monitoring focus:</b> Sockeye Salmon</p> <p><b>Other species observed in area:</b> Beluga whale, rainbow trout, Arctic char, Arctic grayling</p>
Collision monitoring	Video monitoring
Other monitoring	Hydrodynamic monitoring
Seasonality of monitoring	<p><b>Video imagery:</b></p> <p>Juveniles/smolts: May 21, 2021 to June 10, 2021</p> <p>Adults: June 25, 2021 to July 15, 2021</p>
Number of collisions recorded	No collisions observed
Advantages and limitations of monitoring techniques (inclusive of but not limited to)	<p><b>Advantage:</b></p> <p>Provides information on presence, occupancy patterns and behaviour of animals in and around the project site to gain insights into the potential collision risk</p> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Requires good water clarity (low turbidity)</li> <li>• Potential to generate large quantities of data which requires storage</li> <li>• Requires time-consuming manual analysis</li> <li>• Biofouling can affect performance.</li> </ul>

Main consenting concern

Main concern is the ecological effect on fish, including the risk of blade collision and behavioural impacts such as the disruption of migratory behaviour. The Kvichak River is one of the largest supporting natural systems for the sockeye salmon globally

Licensing conditions

N/A

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