

Scapa Flow Scale Test Site Test Support Buoy:

Marine Licence Application – Supporting Document

December 2020



Document History

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1 Introduction

Established in 2003, The European Marine Energy Centre (EMEC) Ltd is the first and only centre of its kind in the world to provide developers of both wave and tidal energy converters with purpose-built, accredited open-sea testing facilities. In addition to EMEC's grid-connected sites, EMEC offers real-sea test sites in the less challenging conditions of Scapa Flow and Shapinsay Sound. These sites provide a more flexible sea space helping close the gap from tank testing and acting as a stepping-stone towards larger scale projects. Such accessible real sea testing enables marine energy developers and suppliers to learn lessons more cheaply, reducing the need for large vessels.

The scale sites are suitable for, but not limited to, the following testing activities:

- Device testing
- Component testing
- New tools, techniques and supply chain solutions
- Monitoring corrosion, biofouling and acoustic instrument packages
- Anchoring, cabling, subsea hub and wet-mate connectors
- Installation tests
- Rehearsal activities
- Testing ROVs and vessel activities
- Operation and maintenance tests
- Training
- Health and safety procedures
- Decommissioning trials
- Research projects

EMEC has various infrastructure available to facilitate testing activities. Bespoke test support buoys can be provided, allowing developers to dissipate electricity generated by their devices and record data. Pre-installed anchor points provide mooring options, and an area of seabed is available for rehearsal or deployment of other tools and techniques. Each test site comprises one berth with pre-laid foundation and attachment points. The pre-laid foundations comprise 5m x 5m x 2m gravity-base frames loaded with densecrete blocks for equipment moorings.

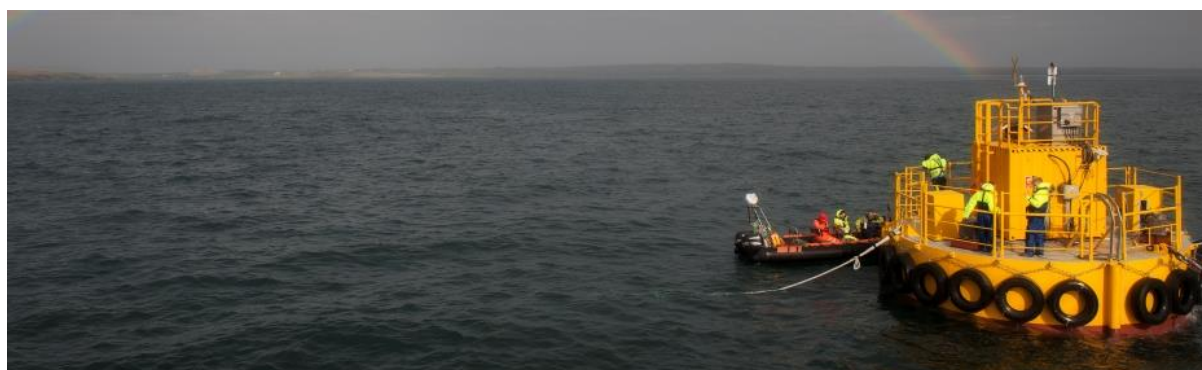


Figure 1. EMEC's test support buoy

This document has been developed to support a marine licence application, under the Marine (Scotland) Act 2010, for the temporary deployment and removal of a test support buoy (TSB) when required and associated moorings. Although the TSB only requires three moorings, there may be a requirement for a fourth mooring to test novel mooring designs in the future. Marine Scotland will be consulted if a fourth mooring is required for a future deployment.

2 Site description

EMEC's non-grid connected scale test sites are situated adjacent from the Orkney mainland.

2.1 Scapa Flow wave test site

The site in Scapa Flow, to the south of Kirkwall, was chosen for its relatively benign waters which have 0.5m significant wave height with a predominantly westerly wave regime. The site has water depths of between 21m-25m and is situated in an area of approximately 0.4km across by 0.9km in length.

2.1.1 Location

The scale wave test site is situated adjacent to Orkney Mainland near St Mary's, within Scapa Flow. Table 1 provides the coordinates of the boundary corners of the site.

Table 1. Boundary coordinates (WGS 84) for Scapa Flow scale test site

Test Site	Corner 1	Corner 2	Corner 3	Corner 4
Scapa Flow	58° 53.950'N 002° 56.500'W	58° 53.170'N 002° 56.500'W	58° 53.170'N 002° 57.500'W	58° 53.950'N 002° 57.500'W

Figure 2 below shows the location and depth range of the test site. The area within the dark blue rectangle is leased by EMEC from the Crown Estate Scotland for the purpose of operating the scale test site. This marine licence application is for the continued deployment of EMEC's infrastructure within the boundaries of this area.

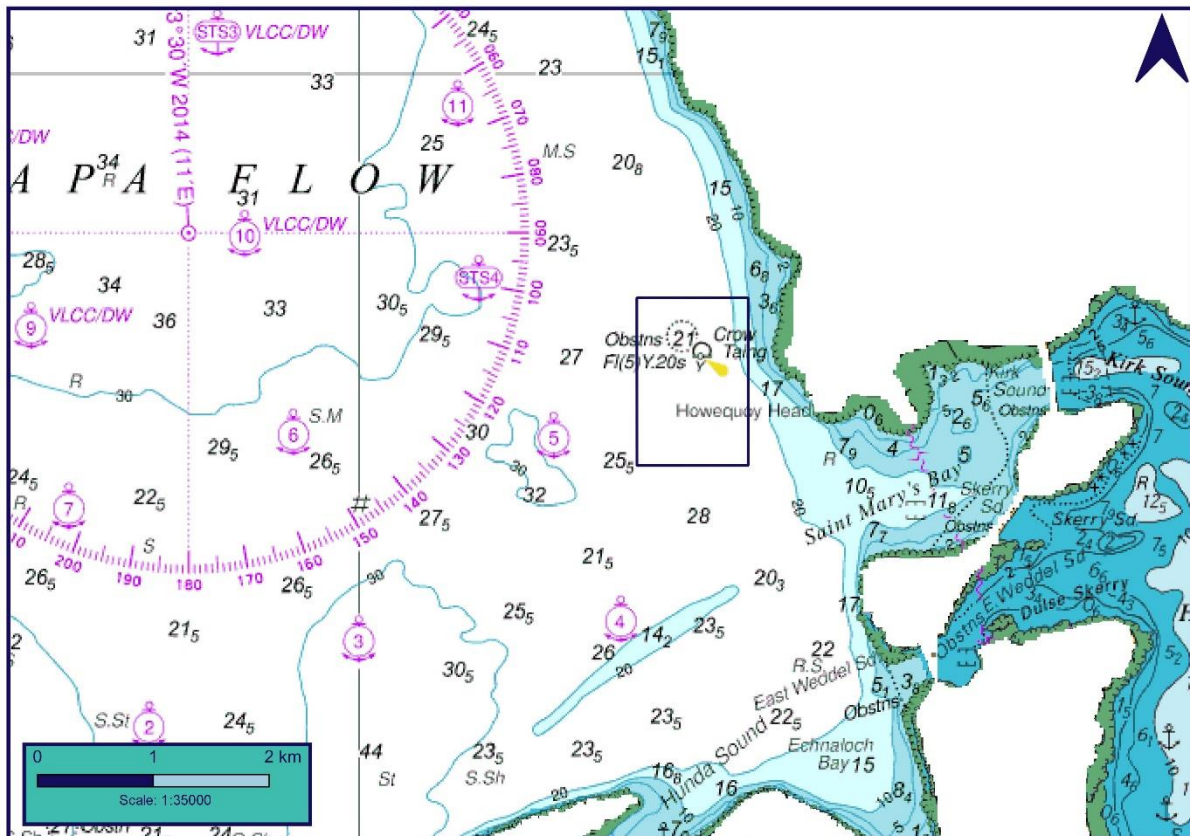


Figure 2. Scapa Flow scale test site (marked in dark blue)

2.2 Facilities

The scale test sites offer flexibility to the developers allowing the developers to choose between the following possibilities:

- Use of the leased area, providing own moorings and means of power dissipation
- Use of the leased area and EMEC moorings but providing own power dissipation
- Use of the leased area, EMEC moorings and EMEC test support buoy#

2.3 Proposed marine licence boundary

Figure 3 shows the proposed marine licence boundary outlined in red and the site boundary outlined in blue.

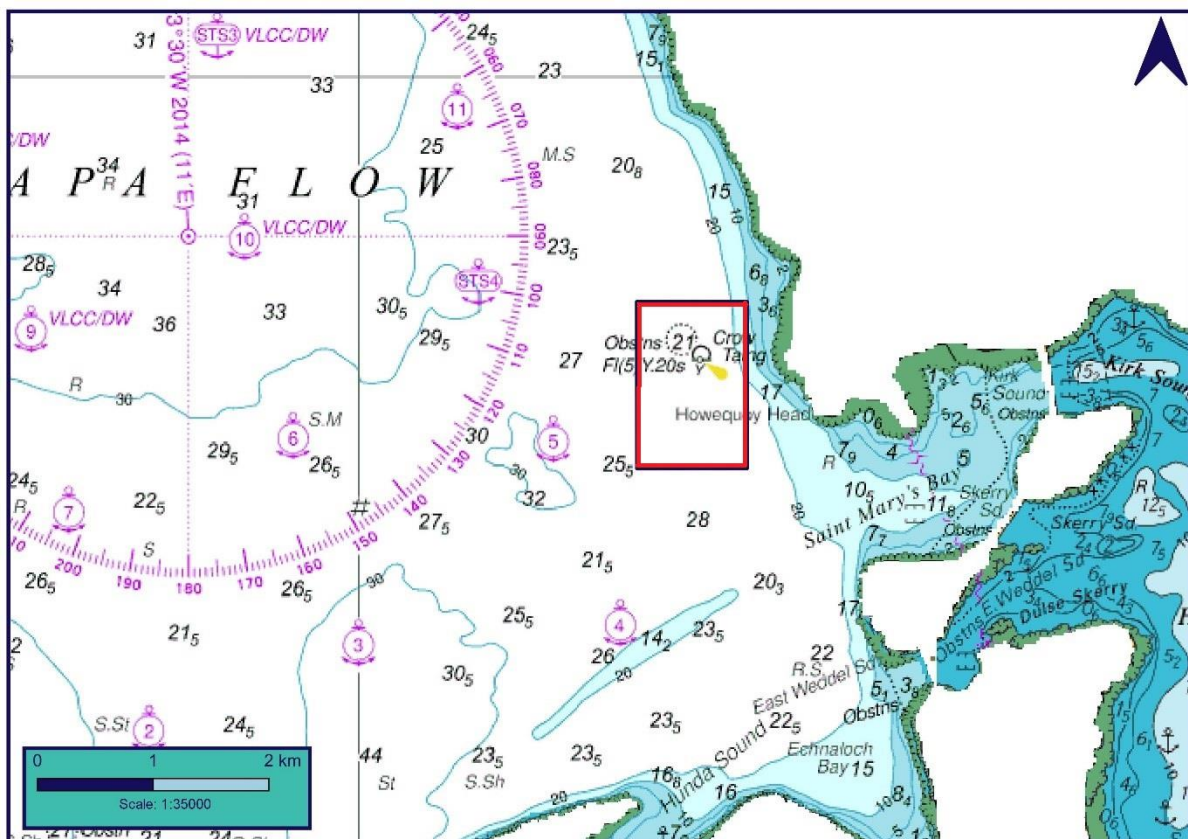


Figure 3. Proposed marine licence boundary (marked in red)

2.3.1 Test support buoy

The test support buoy (TSB) can be connected to a test device or equipment to aid power transmission and control and communications. It is a 7m diameter, 2m high structure which serves three key purposes, which are as follows:

- Equipped to supply power but can also act as a power sink to allow load-dumping of any electricity generated by the device under test as heat dissipated to air;
- Enables measurement of device performance and facilitates data transfer to shore via wireless technology allowing developers to monitor performance remotely;
- Enables testing of novel mooring designs; and
- Equipped to act as a navigational aid when present on the site.

EMEC have two TSBs, one for each of its scale test sites. The TSBs can be deployed to support a developer's testing programme (there may be occasions when a developer does not require the services of the TSB when testing their device). The TSB can also be used to test novel mooring designs. It may also be necessary to install the TSB in advance of a device being deployed on site. Deployments and infrastructure present at the site will be promulgated to other mariners through the usual mechanisms e.g. Notice to Mariners, updating of UK Hydrographic Office charts.

2.4 Deployment

It is expected that this licence will cover all TSB deployments for a period of five years. During these five years, the TSB will be deployed and removed from site as and when required. Marine Scotland will be informed of any plans to deploy the TSB through submission of a

Project Information Summary (PIS) which will include all relevant information. Standard procedures will also be followed by EMEC and the marine contractors when carrying out works on-site (e.g. Notice to Mariners).

Deployment of the TSB would be expected to take place over a one day time period. A multi-cat vessel would transport and deploy the TSB via a lifting mechanism. The multi-cat vessel would depart from Stromness harbour or Hatston pier and would take all necessary precautions as listed in the Environmental assessment. For removal, it would be the reverse of installation.

This PIS will also cover the soonest expected deployment of the TSB which will be to support the AWS testing campaign. The AWS device deployment is covered by a separate licence.

2.5 Moorings

If no additional moorings are required, the TSB will use three individual chain moorings attached to three individual GBAs.

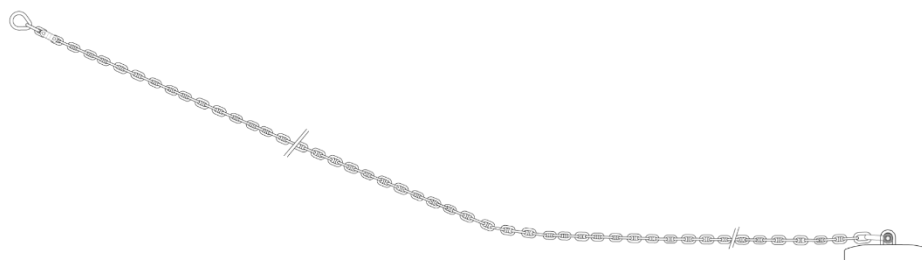


Figure 4. Typical mooring line configuration for the TSB

Table 2. List of materials associated with TSB mooring line

Components:	Qty:
Ø=24mm, Pear link	1
H-Link DN24mm	1

Ø=24mm, L=104 m, Studlink Chain Section	1
Ø=24mm, End link	1
Gravity Base Anchor (covered by another licence)	1

2.6 Additional moorings

As mentioned previously, the TSB can be used for testing novel mooring designs. The TSB is typically anchored to three permanently installed GBAs, while a fourth GBA must be installed temporarily to accommodate novel mooring testing. All GBAs are covered by another licence. This means that there could be either three or four moorings associated with the TSB deployment. Marine Scotland will be informed before each deployment as to the number of moorings associated with the TSB. If testing a novel mooring concept, specifications will be submitted to Marine Scotland before deployment, and further consultation may be required before deployment.

2.7 Maintenance schedule

When the TSB is installed onsite for longer periods of time, it may be necessary to conduct minor maintenance work. If this work requires divers, a methodology will be submitted to the regulator four weeks prior to works commencing.

Marine Scotland will be notified in advance of maintenance activities via a Notice to Mariners.

2.8 Removal and decommissioning

The TSB and associated moorings will be removed from the site once the given testing period has concluded. The only infrastructure to be left on the site after removal of the TSB and moorings are the permanent GBAs, however, a separate licence application will cover these.

3 Environmental receptors

An Environmental Description of the site was originally prepared when the site was established. An update of this document is available on request from EMEC, or through it's website (<http://www.emec.org.uk/facilities/scale-test-sites/>). This section will discuss the impact of the TSB and GBA, however this document will be submitted in support of the TSB marine licence application.

3.1 Physical conditions

As the Orkney Islands are situated off the north coast of Scotland, they experience high exposure levels with frequent gale force winds and rain. Frequent mobile depressions affect the area with low cloud and rain being the prevailing weather conditions. However, during the winter months, temperatures generally do not fall as low as those experienced across the Scottish mainland; the archipelago of islands benefits from a mild maritime climate.

Surrounded almost entirely by land, Scapa Flow forms a shallow, natural harbour with numerous inlets and bays. It is a relatively shallow inland sea which exhibits a pronounced shelf. Water depths across the test site range from approximately 15m to 30m but are

predominantly between 21m and 25m. The seabed sediments and communities within the Scapa Flow test site were the subject of a number of site surveys, as part of the site selection process. EMEC commissioned both geophysical surveys (Netsurvey Ltd, 2010) and environmental sampling that included the collection of grab samples across the site aimed at determining biota and sediment particle size (Biotikos, 2010). A sand wave lying WSW-ENE across the southern section of the area was found to rise up to a depth of 14.8m (Netsurvey Ltd, 2010). The survey also identified a number of contacts across the area which are assumed to be boulders or rocks. The sample survey indicated a moderately low energy site that is characterised by stable sands of quite fine consistency (Biotikos, 2010). The habitat could be broadly classified as 'Sheltered Muddy Gravels' and subcategorised as 'Subtidal Mixed Sediments'.

The site's energy resources have been assessed using surface-mounted waverider buoys with integral downward pointing ADCP for measuring currents. Multibeam sonar, sub-bottom profiling and magnetometer surveys have also been completed (Netsurvey Ltd, 2010).

3.2 Marine mammals

A wildlife observation project commenced at the Scapa Flow test site in April 2010 to gain site description and species data. The observation project was completed in March 2013 as it was deemed that sufficient data had been collected to realise a site characterisation. Fully-trained observers carried out the observations through regular scanning of the test site by telescope (20x - 60x magnification). Observations were carried out from a single elevated vantage point at Howequoy Head, St Mary's; a total of 534 hours of observations were captured (EMEC, 2013b). Further information regarding the observation project can be obtained from the Marine Scotland Information website (<http://marine.gov.scot/>) or can be requested from EMEC.

The following table provides a list of the marine mammal species sighted during the observation project.

Table 3. Marine mammal species counts at the Scapa Flow site for the period June 2010 - March 2013 (summer: April - September and winter: October - March) (EMEC, 2013b)

SEALS	Summer	Winter	Total
Harbour seal	24	88	112
Grey seal	79	46	125
Unidentified seal	51	114	165
CETACEANS & OTHER	Summer	Winter	Total
Harbour porpoise	48	24	72
Minke whale	0	0	0
White-sided dolphin	0	0	0
Risso's dolphin	4	5	9
Orca	3	0	3
Unidentified cetacean	0	1	1
Basking shark	0	0	0
Otter (European)	0	0	0

3.3 Marine birds

The wildlife observation project also captured seabirds sighted across the Scapa Flow test site (EMEC, 2013b). A summary of the observations is provided in the table below.

Table 4. Bird species counts at the Scapa Flow site for the period June 2010 - March 2013 (summer: April - September and winter: October - March) (EMEC, 2013b)

BIRDS	Summer	Winter	Total
Arctic skua	7	0	7
Arctic tern	337	0	337
Auk	1	0	1
Black guillemot	4300	1288	5588
Black scoter	21	12	33
Black-throated diver	94	437	531
Common guillemot	2531	695	3226
Common scoter	0	0	0
Common tern	9	0	9
Cormorant	1	3	4
Diver sp.	0	0	0
Eider duck	1854	2581	4435
Eurasian wigeon	20	256	276
Fulmar	1292	746	2038
Gannet	1371	656	2027
Goldeneye	0	21	21
Goosander	0	0	0
Great black-backed gull	280	190	470
Great northern diver	1309	3729	5038
Great skua	376	0	376
Greylag goose	1120	573	1693
Grey phalarope	0	4	4
Herring gull	69	148	217
Iceland gull	0	1	1
Kittiwake	145	102	247
Leach's storm petrel	1	0	1
Little auk	0	57	57
Little grebe	0	1	1
Long-tailed duck	795	1310	2105
Mallard duck	2	2	4
Manx shearwater	7	0	7
Mew gull	64	1838	1902
Phalacrocorax spp.	0	0	0
Pink-footed goose	0	1	1
Puffin	130	14	144
Razorbill	579	71	650

Red-breasted merganser	106	205	311
Red-necked grebe	3	34	37
Red-throated diver	170	60	230
Sandwich tern	10	0	10
Shag	3117	1829	4946
Slavonian grebe	43	1125	1168
Storm petrel	54	4	58
Velvet scoter	97	129	226
Yellow-billed diver	2	0	2
Unidentified auk	1630	693	2323
Unidentified diver	5	11	16
Unidentified grebe	0	1	1
Unidentified gull	210	80	290
Unidentified tern	96	0	96
Unidentified bird	0	0	0

3.4 Fish

Despite few fish studies for the site, generalised statements regarding the fish species present at the site can be inferred from the location of the test site and the known seabed conditions. Species typical of north Scottish waters are expected to inhabit the Scapa Flow test site, for instance: pollack *Pollachius pollachius*, saithe *Pollachius virens*, ling *Molva molva*, ballan wrasse *Labrus bergylta* and cuckoo wrasse *Labrus mixtus* (EMEC, 2011). Less abundant species include poor cod *Trisopterus minutus*, goldsinny wrasse *Ctenolabrus rupestris*, conger eel *Conger conger* and cod *Gadus morhua* (which is widely distributed around Orkney in the summer months).

There are also migratory and seasonal species that are expected to inhabit the site, e.g., migratory mackerel *Scomber scombrus*, juvenile and non-spawning adult monkfish *Lophius piscatorius* and gurnard *Triglidae spp.* The site has also overlaps with an area identified as a potential spawning area for commercially important fish species, e.g. herring, lemon sole, sand eels, spratt. Saithe, lemon sole, sandeel and sprat use the area as a nursery ground year-round (Coull *et al.*, 1998).

3.5 Benthos

Marine Scotland collected video and photographic stills imagery from this area of Scapa Flow as part of a wider marine survey programme requested by Scottish Government. This information has subsequently been reviewed by Scottish Natural Heritage (Moore, 2009) to provide a description of the seabed habitats, species assemblages and biotopes. The study found that the site was composed of flat muddy sand seabed covered with a patchy mat of loose-lying red algae, consisting principally of the red seaweed *Phyllophora crispa* and occasional balls of *Trailliella*, a life phase of the red algae *Bonnemaisonia hamifera*. The biotope classification is namely SS.SMP.KSwSS.Pcri. Moore (2009) also reported that the infauna observed included sparse occurrences of the sand mason *Janice conchilega*, the tube anemone *Cerianthis lloydii* and terebellid worms. Epifauna included occasional harbour crab *Liocarcinus depurator*, queen scallop *Aequipecten opercularis* and the common starfish *Asterias rubens*.



Figure 5. Seabed image within Scapa Flow test site showing flat muddy sand and loose algae (Site SF/1; Moore, 2009)

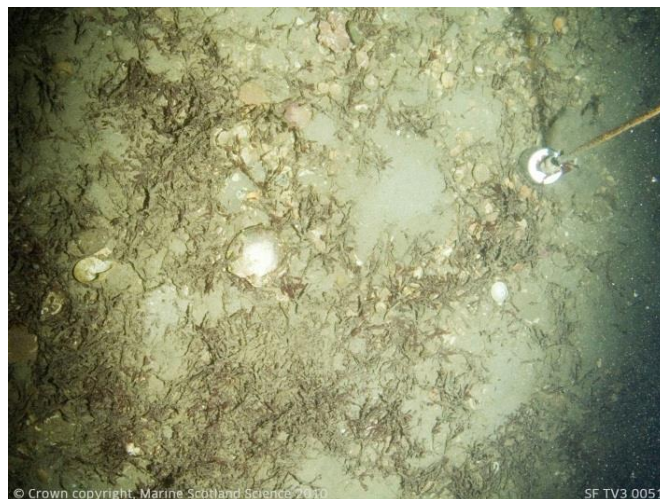


Figure 6. Seabed image within Scapa Flow test site showing flat muddy sand, pebbles and loose algae (Site SF/3; Moore 2009)

3.6 Conservation areas

The Scapa Flow waters attract some of the largest Scottish marine bird concentrations due to the numerous inlets and bays that provide a sheltered area in which birds can moult, roost, rest and feed. Over 20% of the British great northern diver population, 10% of black-throated divers and the largest concentration of Slavonian grebe in Britain winter in Scapa Flow. In summer, Scapa Flow provides important feeding grounds for breeding red-throated divers. The varied habitats and numerous wrecks support a wide diversity of fish and invertebrates (such as marine worms and shellfish), upon which the birds feed. Divers, grebes, shags and sea duck feed by surface diving. These rich waters provide excellent foraging habitat for both non-breeding and breeding birds.

The Scapa Flow test site is within a proposed Special Protection Area (Orkney Inshore Waters pSPA, previously the Scapa Flow pSPA) due to its qualifying bird species, as listed in Table 5.



Figure 7. Boundary of Scapa Flow pSPA

Site name	Protection status	Reason for protection
Loch of Stenness	Special Area of Conservation	Coastal lagoons.
Lochs of Harray and Stenness	Site of Special Scientific Interest	Aggregations of non-breeding birds: goldeneye, pochard, tufted duck, scaup. Saline lagoon. Eutrophic loch. Freshwater nerite snail and caddis fly.
Orkney Mainland Moors	Special Protection Area	Presence of breeding hen harrier red-throated diver and short-eared owl.

Hoy	Special Protection Area	Aggregations of breeding birds: Arctic skua, great black-backed gull, guillemot, kittiwake, red-throated diver, fulmar, puffin, great skua, peregrine and seabird assemblage.
Hoy	Special Area of Conservation	Base-rich fens, alpine and subalpine heaths, blanket bog, plants in crevices on base-rich rocks, dry heaths, acid peat-stained lakes and ponds, wet heathland with cross-leaved heath, hard-water springs depositing lime, vegetated sea cliffs.
Hoy	Site of Special Scientific Interest	Geological notified features include: coastal geomorphology of Scotland, Old Red Sandstone Igneous, Quaternary period of Scotland and non-marine Devonian. Notified biological features in terms of habitats include blanket bog, dystrophic loch, upland assemblage and upland oak woodland. In terms of notified bird features, there is a breeding bird assemblage present and a breeding seabird colony. Other notified bird species include: Arctic skua, fulmar, great black-backed gull, great skua, guillemot, peregrine and red-throated diver.
Hoy and West Mainland	National Scenic Area	A palimpsest of geology, topography, archaeology and land use. An archaeological landscape of World Heritage Status. Spectacular coastal scenery. Sandstone and flagstone as an essence of Orkney. Long-settled and productive land and sea. The contrast between the fertile farmland and the unimproved moorland. A landscape of contrasting curves and lines. Land and water in constantly changing combinations under the open sky. The high hills of Hoy. The townscape of Stromness, its setting and its link with the sea. The traditional buildings and crofting patterns of Rackwick.
Scapa Flow	Proposed Special Protection Area	Breeding birds: red-throated diver. Non-breeding birds: black-throated diver; common eider; European shag; great northern diver; long-tailed duck; red-breasted merganser; Velvet scoter and Slavonian grebe.

Table 5. Designated sites near to Scapa Flow test site

3.7 Cultural heritage

Scapa Flow was the base for the Royal Navy Home Fleet in both the first (WWI) and second (WWII) World Wars and, as such, several both WWI and WWII military remains can be found at points around the coast. As the German High Seas Fleet was scuttled in Scapa Flow at the end of WWI, the remains of relatively intact wrecks are in the south and west of the Flow, much to the south of Scapa Flow. Of more site-specific interest relative to Scapa Flow, the remains of HMS Royal Oak are located approximately 4 km to the north.

There is the potential for the presence of submerged landscapes preserved by the accumulation of sediment. However, interrogation of the RCAHMS, Historic Scotland and Local Authority Sites and Monuments Records database shows that, whilst there are sites of archaeological interest along the nearby coast, there are no known archaeological sensitivities in the Scapa Flow test site area.

4 Environmental assessment

A full Environmental Impact Assessment has not been completed with respect to this application. As this application is for the continued deployment of infrastructure at the site, there are not expected to be any additional environmental impacts associated with the works pertaining to this application.

4.1 Environmental monitoring

During maintenance activities and the TSB installation and removal, normal precautions will be adhered to. Any necessary changes will be agreed with Marine Scotland in advance.

The following table provides an overview of the proposed mitigation and monitoring measures that will be employed at the site. If there are any unexpected deviations from the proposed measures, these will be reported on no later than 48 hours from the event. Figure 5 provides the location of the designated haul out sites referred to in the proposed measures.

Table 6. Proposed mitigation and monitoring measures

Measure summary	Description
During all vessel movements to and from site, a minimum approach distance will be adhered to when passing designated seal haul-outs.	A distance of greater than 500m from any designated seal haul-out site will be maintained. Such an exclusion zone around haul-out sites will be maintained unless personnel or vessel safety does not permit.
	The sensitive periods for both grey and harbour seals will be considered when planning maintenance work. The sensitive period for grey seals is understood to be between September and December whereas, for harbour seals, it is late May to August.
During all works onsite and vessel movements to and from site, the relevant measures within the Scottish Marine Wildlife Watching Code (SMWWC) will be adhered to.	Vessel speeds will be reduced to 6 knots when marine mammals or birds are sighted within or near transit routes, where personnel or navigational safety is not compromised.
	In the event of a marine mammal approaching a vessel associated with the works, the course of the vessel will be maintained at a steady speed.
	Particular care will be taken to ensure groups and mothers and young are not disturbed/split.
	As stated in the SMWWC, minimum approach distances for vessels will be adhered to.

Measure summary	Description
	<p>Sudden changes in speed, duration and engine noise will be avoided to reduce any disturbance to marine mammals in the vicinity.</p> <p>Rafts of birds will not be intentionally flushed.</p> <p>If maintenance activity is undertaken during the seabird breeding season (likely to be between April and August), a vessel transit corridor of at least 50m from the shoreline will be maintained.</p>

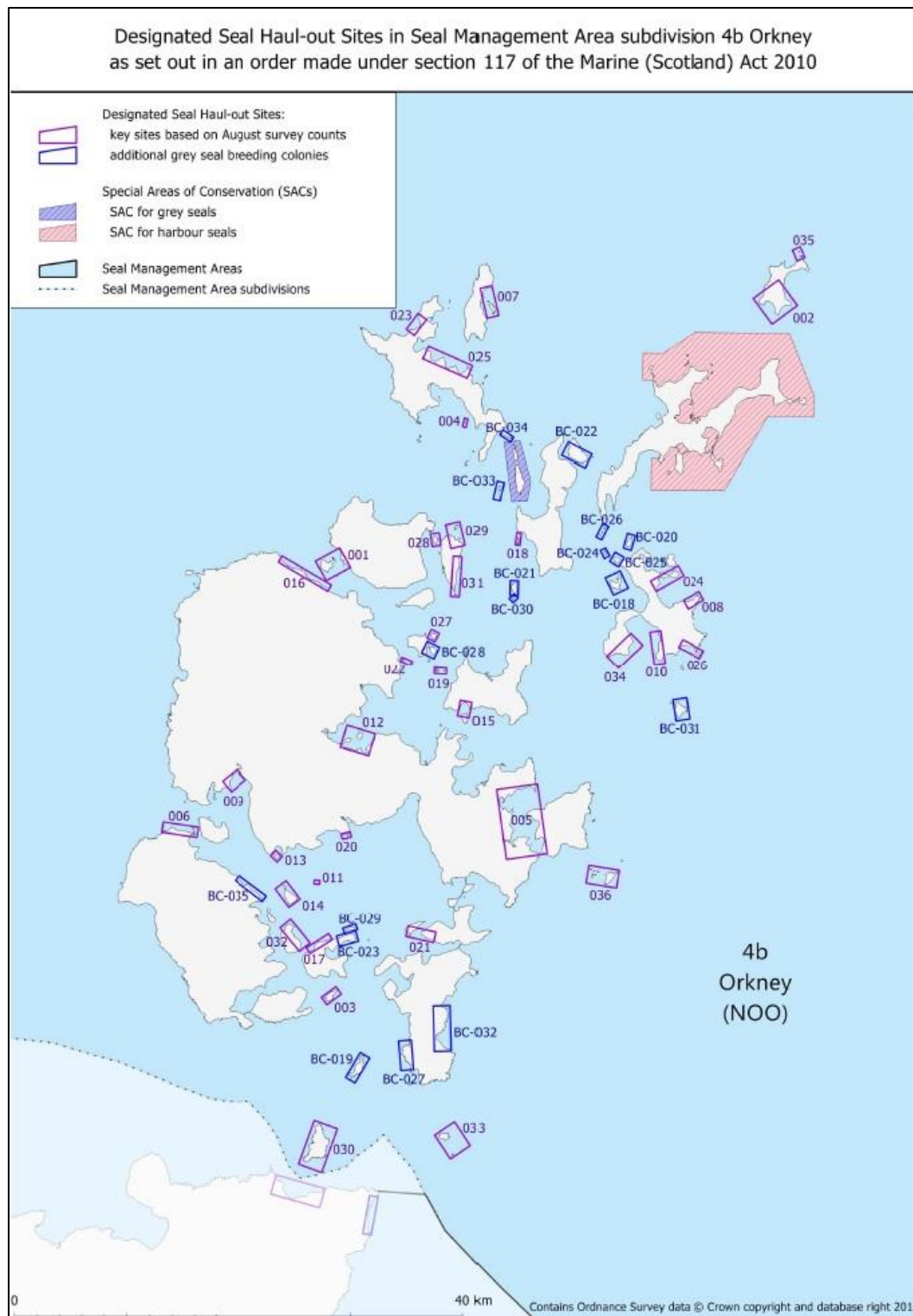


Figure 8. Designated seal haul-out sites in Seal Management Area subdivision 4b Orkney as set out in an order made under section 117 of the Marine (Scotland) Act 2010

5 Navigational risk assessment

A site-wide assessment considering all potential navigational impacts that could occur during operation of a scale test site including the installation, operation, maintenance and decommissioning of a wave device at the Scapa Flow test site was conducted. This assessment has been submitted as supporting documentation to this application, see Scapa Flow Scale Wave Site Navigational Risk Assessment (NRA) (EMEC, 2019). As part of the NRA, Automatic Identification System (AIS) and Vessels Monitoring System (VMS) data were used to assess the existing traffic patterns at the test site.

5.1 Shipping and fishing activity/other users

As the test site lies within Scapa Flow, the types of vessels identified as using the area are typically: ferries plying to and from the southern isles of the Orkney Islands, namely Hoy and Flotta, operated by Orkney Ferries and private charter; fishing vessels accessing fishing grounds off the west coast of Orkney Mainland; dive boats on passage to the many dive sites around Scapa Flow; and yachts visiting the ports located around Orkney. It should also be noted that the RNLI has lifeboat stations at Stromness and Kirkwall (Scapa) so the lifeboat may pass the site when engaged in activities.

There is very little commercial shipping activity through or near to the Scapa Flow test site, with the largest vessels excluded through the IMO adopted ATBA. There is no ferry traffic. However, very significant vessels anchor at nominated anchorage locations to the west of the site and may be engaged in STS hydrocarbon transfer operations. These activities are well regulated by the Statutory Harbour Authority.

Between April and September, a significant number of cruise ships visit Orkney. The main destination port for these large vessels is traditionally Hatston Pier (Kirkwall) on the eastern side of Orkney Mainland; however, more recently, cruise ships have begun to utilise the port of Stromness. There is little chance that cruise ships will come in close proximity to the test site.

5.2 Assessment

As the site-wide NRA includes EMEC's infrastructure (deployed GBAs and TSB), the assessment will remain true and the appropriate mitigation measures should be applied. These mitigation measures have been summarised in the table below.

Table 7. Embedded mitigation measures

Embedded mitigation measure	Description
PPE Requirement	Maintenance teams to wear suitable PPE when working on the devices, including life jackets.
Training of staff	Staff to be trained to the required standards for their work and have suitable local knowledge of regulations and operations in the Orkney Islands.
ERCoP	ERCoP for site has been developed and agreed with the MCA and SAR bodies.
NTM and Promulgation	In addition to NtM, EMEC's Maritime Safety Information Standard Operating Procedures (SOP) ensures that all key navigational consultees are informed prior to any works. Distribution could include HMCG, Orkney Harbours (available via Orkney Islands

	Council Marine Services website), Orkney Marina noticeboards (as necessary), Orkney Fisheries Association, Scottish Fisheries Federation and UKHO. Stakeholders are targeted with information about relevant projects based on their activities and location.
Incident monitoring and reporting	EMEC to encourage incident/near miss reporting and monitor any safety issues at the test site. If necessary, risk control to be reviewed. Risk assessments to be reviewed following any incidents.
EMEC Procedures	EMEC has a number of SOPs and standards in place to reduce navigation risks, such as: <ul style="list-style-type: none"> • Task risk assessment; • Control of work <ul style="list-style-type: none"> ○ Permit to work; ○ Permit to access site; • Hazard identification reporting; and • Maritime safety information.
Charting	Site is marked on nautical charts.
Site Monitoring	EMEC's SCADA system provides real-time status information, trends, alarms and remote-control access to facilitate a safe working environment, comprehensive assessment and safe operation of the sites. Note – only relevant if test support buoy is deployed
Liaison with local stakeholders	EMEC regularly liaises with key local stakeholders to identify any potential issues as soon as possible. Regular updates include information regarding upcoming deployments and significant operations at the site.
500m advisory ATBA	A 500m advisory ATBA exists around all test devices located at EMEC test sites.

Additional mitigation measures can be applied to the deployment of the TSB and these are listed below in Table 8.

Table 8. Possible additional mitigation measure associated with TSB deployment

Possible measure	mitigation	Description
Heightened monitoring in adverse met-ocean conditions		During gale force winds, periodic monitoring of the TSB is recommended to ensure excessive forces are not acting on the moorings which might cause a breakout.
Inspection and maintenance programme		Regular maintenance regime undertaken by EMEC to check the TSB, its fittings and any signs of wear and tear. This should identify any failings which might result in a mooring failure and breakout.
GPS alert system for turbine moving		Remote monitoring of TSB to detect any major movements that might indicate a breakout for immediate response. Implement GPS excursion monitoring.
Marking and Lighting		TSB to be lit to the requirements of NLB and marked in line with IALA guidance. Appropriate statutory sanctions must be in place

Possible measure	mitigation	Description
		to exhibit, alter or discontinue lighting. Light pattern is a standard 5 yellow flashes for a Special Mark.
Liaison with local stakeholders		Orkney Islands Council Marine Services, the MCA and NLB will be notified prior to installation of the TSB to confirm that adequate risk controls are in place. EMEC also conducts regular stakeholder consultation events to ensure that local marine users are aware of the pipeline of activity.
Installation, maintenance and removal		All vessels undertaking activities on site should comply with EMEC standard operating procedures. Vessels should be mindful of other navigating vessels and avoid disrupting the activities of others.

5.3 Hazard identification and risk assessment

A Hazard Identification and Risk Assessment (HIRA) was conducted as part of the Scapa Flow Scale Wave Site Navigational Risk Assessment (EMEC, 2019). This HIRA included the identification of the hazards and necessary controls associated with the test site infrastructure and deployment of TSB. As this application is for the continued deployment of the GBAs and regular deployment of the TSB, it is not expected that an HIRA will be required in connection with any of the work relating to this application. However, EMEC will apply its judgement and expertise in deciding if an HIRA will be needed for any maintenance procedures undertaken.

A HIRA would be expected to be undertaken in collaboration with the developer if the TSB was being deployed onsite in the same operation or through simultaneous operations with a test device onsite.

As the removal/decommissioning of the anchors will be applied for under a separate marine licence, an HIRA will be undertaken in association with the latter application.

6 References

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Annex A: Drawing of infrastructure

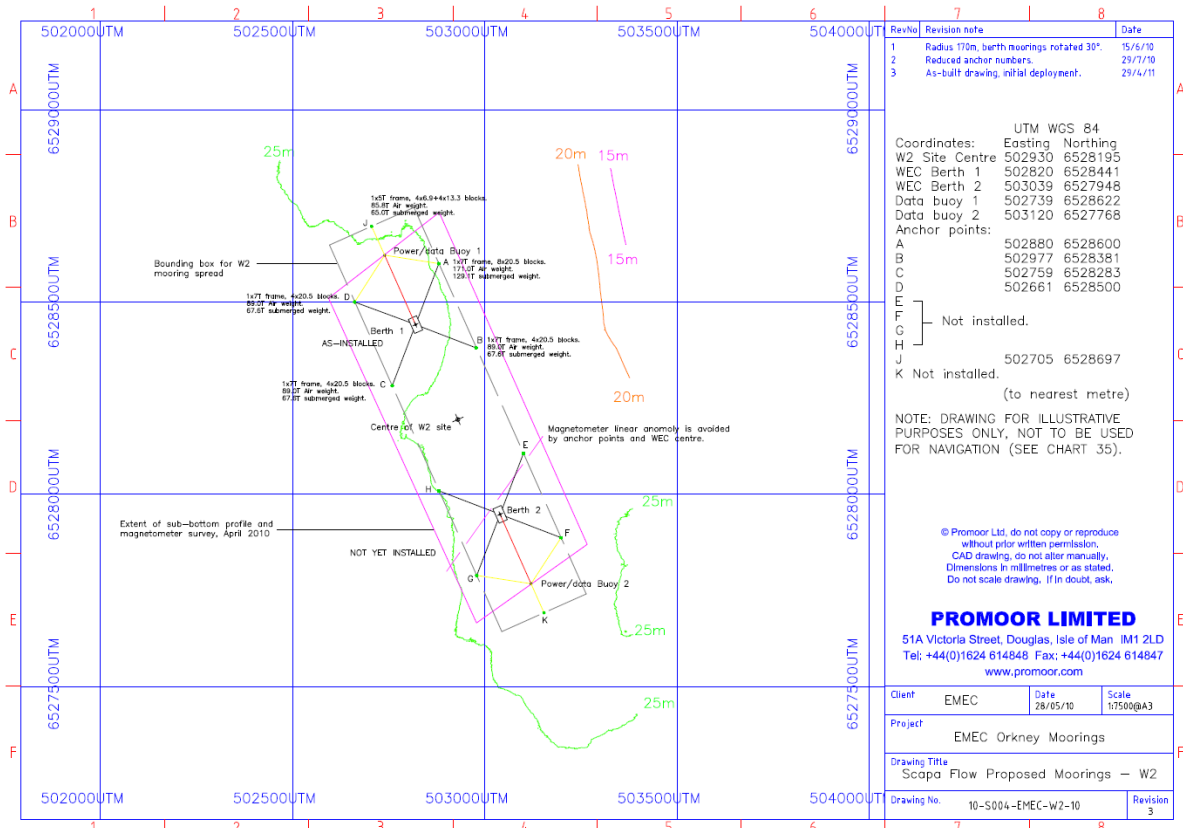






Figure 9. As built layout of the Scapa Flow scale wave test site

Annex B: Description of test support buoy

The test support buoy comprises a main 415V switchboard, Load Banks, Communications package and both AC and DC UPS systems. The buoy acts as a controlled load and measurement point for the test devices. Two low power distribution boards with spare capacity are housed within the distribution compartments of the main switchboard. The main switchboard is of modular design so can be modified readily providing a flexible package for a wide range of applications. The parameters, status signals and CCTV video stream being transmitted across the communications to the EMEC base station / SCADA. The buoy package is self-contained and does not need physical connection to the shoreline. Two 250m umbilical cables, one for power and the other for controls and communications, connect the buoy to the test device. The buoy comes complete with its own navigational aids (amber beacon 3 nautical miles with yellow St Christopher Cross; solar, mains and battery fed) mounted on the enclosure roof. The roof has additional space to accommodate additional instruments and meters, if required.

Section	Image	Dimensions
Platform		7 metres diameter x 2 metres high; draft when laden 0.5m; weight approx. 12 tonnes
Container		Standard 8ft container housing switchgear etc. Topgear includes solar powered navaid and loadbanks, CCTV; weight approx. 2.5 tonnes
Umbilical		250mm umbilical comprising 415V power and copper data comms cables, dry mate connectors both ends

Section	Image	Dimensions
Mooring lines and shackles		120 tonne shackles for connecting ropes to GBAs on seabed; 3 x 100 metre ropes for Shapinsay Sound site; 3 x 140 metre ropes for Scapa Flow site
Surface buoyancy units for mooring lines		6 x MCMC 500kg/10MSW buoys – 3 per buoy (one per mooring line)

The European Marine Energy Centre Limited

The Charles Clouston Building, ORIC, Back Road, Stromness, ORKNEY, KW16 3AW

Tel: 01856 852060

Email: info@emec.org.uk

Web: www.emec.org.uk

Registered in Scotland no.SC249331

VAT Registration Number: GB 828 8550 90
