Annex B Proposed activities screened into the Annex IV Risk Assessment

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Annex Table A: Proposed Activities screened into the Annex IV Risk Assessment (PC = Pre-construction; C = Construction; O = Operational, D = Decommissioning).

Activity	Source	Description	Location	Phase
Geotechnical Surveys	Boreholes	A borehole is a method of drilling into the seabed to recover samples and enable downhole geotechnical testing to be completed. A drilling head is lowered to the seabed via a drill string and potentially stabilised using a seabed frame if required. The drill string is then rotated to commence boring. Tools are lowered into the drill string to recover samples or conduct in-situ soil testing such as downhole CPTs. Downhole geophysical tools will be used post completion of the borehole for further tata collection.	To be deployed at WTG Substructure, Inter Array and Export Cable and Jack-Up locations across the Proposed Development	PC
	CPTs	CPTs are a method for measuring the soils strength and stiffness parameters using a rod-shaped tool whose end has the shape of a cone with a known apex angle (e.g. 60 degrees) which is pushed at a constant speed into the soil. CPTs can be performed in seabed mode, down-hole mode or as a seismic CPT.	To be deployed at WTG Substructure, Inter Array and Export Cable and Jack-Up locations across the Proposed Development	PC
	Vibrocore	Vibrocore is a method of collecting un-consolidated seabed samples. A vibrocorer is lowered onto the seabed, position and depth are noted, after which the vibrocoring process is started. Upon refusal or at target depth, the stop condition is recorded and the vibrocorer is recovered on deck where the recovery rate is measured.	To be deployed at Inter Array and Export Cable locations across the Proposed Development	PC
	Grab Samples	Benthic grab sampling will be carried out by lowering a lightweight sampling device from the vessel, either by crane or handheld device depending on requirements. Upon returning grab samples to the deck, material will be sieved, examined and logged and then stored in a suitable medium in a sealed container for a comprehensive laboratory analysis on land.	To be deployed at Inter Array and Export Cable locations across the Proposed Development	PC
Geophysical Surveys	SBPs (Pinger/Chirp/Boomer/Sparker)	SBP is used to develop an image of the subsurface, identifying different strata encountered in the shallow sediments. This	Proposed Development	PC, O

Activity	Source	Description	Location	Phase
		device will have a primary and secondary frequency range of 0.5 – 15 kiloHertz (kHz) and source levels of up to 245 dB re 1 µPa at 1 m (root mean square (rms)). It would be used in both nearshore and offshore areas. The boomer, with sound source levels in the range of 208-215 dB re1µPa at 1 m (rms), would be used in the nearshore shallower areas; while the sparker system, with source levels in the range of 204-219 dB re 1 µPa at 1 m (rms), would be used in offshore areas.		
	MBES	MBES is a system for collecting detailed topographical data of the seabed. The MBES will be hull mounted. The equipment will operate within a frequency range of 200 – 700 kHz and with sound source levels in the range of typically 213 – 225 dB re 1 µPa at 1 m (rms).	Proposed Development	PC, O
	Magnetometer	A magnetometer is a passive device that is towed behind a survey vessel. It is used to identify magnetic anomalies and hazard mapping for metal obstructions, shipwrecks and UXO on the surface and in the shallow subsurface. The magnetometer does not emit any sound waves into the marine environment.	Proposed Development	PC, O
	SSS	SSS surveys are used to determine sediment characteristics and seabed features and provides detailed imagery of the seabed. SSS is typically towed behind the vessel on an armoured tow cable. However, some models may be pole mounted on the side of the vessel. This device will have a potential operating frequency range of approximately 100 - 900 kHz in the offshore area with and 540 - 850 kHz in the shallower nearshore area with sound source levels of up to 210 dB re 1 µPa at 1 m (rms).	Proposed Development	PC, O
	Seismic Refraction/Reflection (2D/3D UHRS)	A seismic source is used to carry out a seismic survey which can be described as a chamber of compressed air that is released rapidly into the surrounding water to create an acoustic pulse. An air gun is the most commonly used source because the pulses are predictable, repeatable and controllable, and it uses compressed air which is cheap and readily available. The seismic source system will have an expected operating frequency range of approximately 0.001-1 kHz with sound	Proposed Development	PC, O

Activity	Source	Description	Location	Phase
		source levels of up to 224 dB re 1 µPa at 1 m (Peak Sound Pressure Level (SPLpeak) and 214 dB re 1 µPa at 1 m (rms)		
	USBL	USBL systems are acoustic positioning systems used to track the location of subsea equipment relative to a surface vessel. The system operates by transmitting short acoustic pulses between a transceiver mounted on the vessel and a transponder attached to subsea equipment. USBL systems typically operate at high frequencies and low power levels relative to other acoustic survey sources.	Proposed Development	PC, C, O
Metocean	Floating LiDAR	Floating LiDAR buoys will be deployed to measure the wind resource within the Array Area. Deployment of these buoys will include anchor points on the seabed.	Array Area	PC
	Acoustic Doppler Current Profiler (ADCP)	ADCPs will be used to examine wave and current conditions. This equipment is installed on the seabed and anchored with a suitable mooring structure. It is generally a short-term deployment used to gather seasonal data (e.g. winter storm data) however may be deployed for longer.	Array Area	PC
	Wave Buoy	Wave rider buoys may be deployed to measure wave heights within the Array Area. They will be moored to the seabed by a suitably sized mooring structure.	Array Area	PC
Environmental	Benthic Ecology (subtidal benthic survey)	This survey is designed to confirm the predicted benthic communities and habitats at the site. Subtidal sample locations may be subject to drop down video (DDV) in advance of sampling.	Proposed Development	PC
	Cetacean Porpoise Detectors (CPOD) / Sound Traps	Marine mammal acoustic monitoring will be undertaken using CPODs (click detectors). If used, the CPODs will be deployed on the seabed. Sound Trap hydrophones may be deployed alongside the CPODs for periods throughout the site survey campaign.	Proposed Development	PC
	Habitat Surveys (*Sabellaria* and Mussel Beds)	The data from the confirmatory Geophysical Surveys will be assessed by a benthic ecologist to identify potential habitat locations and inform the transect locations for DDV surveys if required.	Proposed Development	PC

Activity	Source	Description	Location	Phase
Corrosion	Microbial Induced Corrosion Frames	Microbial Induced Corrosion Frames are metal frames used to measure the rate of deterioration of a metal by corrosion processes that occurs directly or indirectly because of the metabolic activity of microorganisms in cold water systems. This type of corrosion results in severe pitting of metals, leading to rapid failures. The type of bacteria that cause this type of corrosion are anaerobic, they can only thrive in oxygen-deprived regions under deposit (Ibraheem, 2011). The outcome of this monitoring will feed into the turbine and OSP foundation design and allow suitable protection measures to be employed to prevent microbial induced corrosion of the turbine infrastructure.	Array Area	PC
Sediment Dynamics	Benthic Flume and Benthic Lander	Benthic flumes and benthic landers are marine instruments which collect measurements on sediment transport processes and parameters directly in the sea. Benthic flumes collect information on entrainment-deposition parameters and the sediment transport rate coefficients which can be fed into the sediment transport model to improve the parameterisation of these variables within the model. Benthic landers are intermediate scale seabed frames equipped with sensors such as ADCP's, single point current meters, turbidity sensors and marine altimeters to measure seabed sediment transport. They provide an open area beneath an upper frame in which sensors are suspended and provide improved measures specifically of near bed hydrodynamic and sedimentary processes.	Proposed Development	PC
ROV surveys	MBES, General Visual Inspections (GVI), Non – Invasive Visual Inspections, Cable Depth of Lowering Surveys	Using a ROV(s) to carry out post installation / as built / O&M surveys for export / inter-array cables / interconnector cables, these could include: MBES, general non-invasive visual inspections and cable depth of lowering surveys with pipeline/cable tracking equipment. These systems monitor or induce magnetic fields in the cable which are then used to determine cable position and vertical displacement. These may take place at cable crossings, substructure base inspections, cathodic protection systems and any planned/remedial rock dumping that may take place.	Proposed Development	O
Dredging, trenching and cable installation	Cable laying	The total lengths, burial depths and routing of inter array, export and interconnector cabling required will depend upon the final	Proposed Development	C

Activity	Source	Description	Location	Phase
		WTG and OSP locations (within the WTG and OSP limits of deviation) as well as site constraints such as wrecks, sensitive habitats and difficult ground conditions such as stiff clays and shallow rock.		
	Dredging	Seabed lowering/features clearance will involve removal of material from seabed features (such as sandwaves or megaripples) by techniques such as dredging, mass flow excavation, water injection dredging or utilisation of pre-lay route clearance ploughs. Additional dredging activities may be required during the operation and maintenance phase for scour protection repair and maintenance of WTG and OSP foundations, as well as maintenance of inter-array cables, interconnector cables and offshore export cables.	Proposed Development	C, O
	Trenching	Trenching will be required during the offshore cable installation; it is expected that the majority of the cable route will be buried via the use of jet trenching	Proposed Development	C
Infrastructure preparation and installation activities	Seabed preparation	Seabed preparation activities will be required in advance of installation activities, and in advance of jack-up vessel placement, to reposition any boulders/debris and to clear seabed features from the seabed. This will include boulder clearance, seabed lowering/feature clearance followed by a pre-lay grapnel run.	Proposed Development	C
	Scour protection	Scour protection will be installed around the foundations to prevent the development of scour holes and may include the use of: concrete mattresses, rock, artificial fronds, rockbags or geotextile sand containers.	Proposed Development	C
	Cable protection	Cable protection will be used where sufficient burial depth within the seabed is not achieved during installation, due to difficult ground conditions being encountered, and at cable crossings.	Proposed Development	C
Foundation installation	Monopile Installation	Monopiles (WTGs and OSPs) will be installed into the seabed by either piling or drilling techniques, or a combination of both (drive-drill-drive), depending on seabed conditions.	Array Area	C

Activity	Source	Description	Location	Phase
		Piling the monopiles using a hydraulic impact hammer is the basecase method for monopile installation. Hydraulic impact hammering may in some instances be fully replaced or complimented by use of a vibro-hammer. As the name suggests a vibro-hammer imparts vibration on the pile and immediate surrounding soil. Vibrohammers are only effective in suitable soil conditions and have limited effect in high strength soils. A hammer energy of 3,500 kJ is considered as the maximum for the purposes of assessment, however the actual energy used when piling will be significantly lower for the majority of the time and locations. The maximum the blow energy imparted on the pile by the hammer has been calculated at 246.9 dB re1µPa at 1 m (SPLpeak) for monopile foundations.		
	Drive-drill-drive	Monopiles may be installed using drive-drill-drive techniques depending on seabed conditions. Potential for drill arisings which may benter the water column dumped at sea. The drill would initially drill out the soil plug within the monopile. The drill continues to drill beyond monopile toe depth scrabbling away the underlying rocks/ dense material layer(s) which are causing excessive resistance to pile driving. When the drill has reached the predetermined target depth it is recovered thr ugh the monopile. The impact hammer is redeployed on top of the monopile and driving resumes until the monopile is driven to target penetration depth.	Array Area	C
Vessels	All vessel types	A range of vessels will be utilised across the Proposed Development across pre-construction surveys, infrastructure installation, and routine maintenance activities. Example of vessel types include: • Smaller jack-up vessels suitable for shallower water depths of the Array Area, nearshore confirmatory surveys at shallower waters near Landfall and ports; and • Larger vessels suitable for Array Area and Cable Corridor and Working Area. Source noise levels for vessels depend on the vessel size and speed as well as propeller design and other factors. There can be considerable variation in noise magnitude and character between vessels even within the same class.	Proposed Development	PC, C, O, D

Activity	Source	Description	Location	Phase
Operational turbines	Turbines	Operation of WTGs involves the rotation of turbine blades and associated mechanical components throughout the lifetime of the Proposed Development. Blade rotation speed varies depending on wind conditions and turbine design parameters, including cut-in wind speed, rated wind speed, and maximum rotational speed. Operational noise generated during turbine operation is primarily associated with vibration transmitted through the turbine structure into the seabed and water column, and is generally continuous and low-level compared to construction activities.	Array Area	O