





DANISH PILOT MANUAL FOR GUIDES

IMPLEMENTATION OF MULTI-USE CONCEPTS WITHIN PILOTS



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1. EXECUTIVE SUMMARY

This document describes the manual used to educate guides taking the visitors to Middelgrunden Wind Farm.

The guide is built up using many appendixes dealing with special issues and the main text is summarising.

The guide can be a form of inspiration for people who want to implement a similar program involving another wind energy farm but note that safety issues may vary from one turbine to another and from one country to another.





2. INTRODUCTION

The Danish pilot is piloting the multi-use combination of offshore wind and tourism, consisting of an in-person boat tour to the wind farm as well as a virtual tour. The pilot is located off Copenhagen in the Middelgrunden offshore wind farm. The wind farm is located relatively close to shore, 3.5 km from Denmark’s capital, visible from the most popular city beach and some rooftops. The wind farm opened in 2000 and produces up to 100,000 MWh of electricity annually, equivalent to three per cent of Copenhagen’s total power consumption.

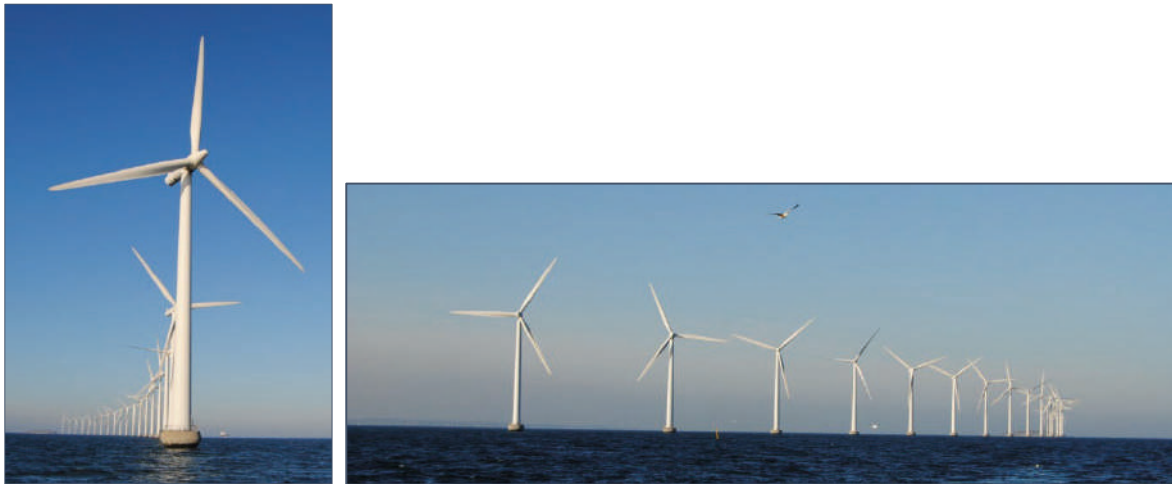


Figure: sea view of the 20 turbines of Middelgrunden Offshore Wind Farm.

The wind farm consists of 20 turbines, each 2 MW, which are equally shared (i.e., 10 each) by its developers “Københavns Energi” (today HOFOR utility) and “Middelgrundens Vindmøllelaug I/S” (Middelgrunden Cooperative), a private cooperative partnership with 8,552 shareholders from the start, today reduced to 7,899.

There are 40,500 shares in total; a share is equal to 1,000 kWh production a year.

At the wind farm project inception, the utility had the financing and engineering expertise in place, while the cooperative gathered positive local citizens, who turned to be advocates and ambassadors of the project to their relatives and friends. Special expertise was also present by members of the cooperative and utilized in the project, - like foundation, wind assessment, law and EIA.

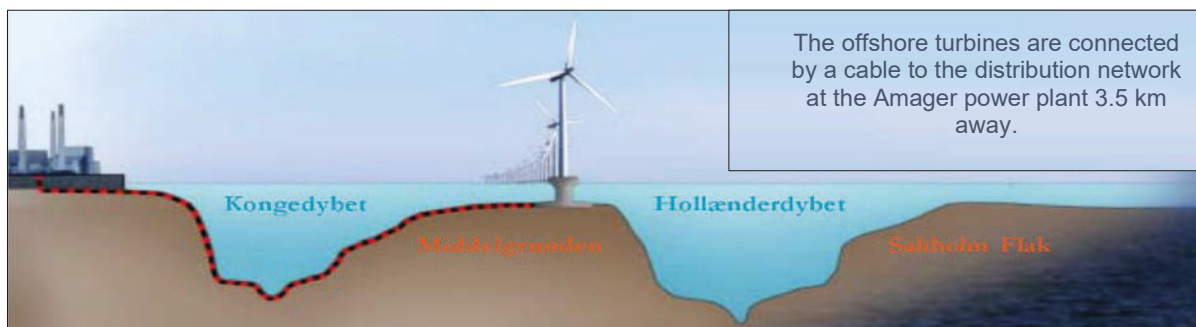


Figure. Bathymetry and cable connection to shore from Middelgrunden offshore wind farm.

The physical tour to the offshore wind farm is organised by representatives of the Middelgrunden cooperative (a board member is organising the trips using his own consulting company SPOK ApS), who also contracts the boat operators. This took place a few years after the commissioning of the wind farm. The other owner of the wind farm has no intention to establish a visiting program. Two boat operators are used for the tour, which is scheduled in advance depending on boat and guide availability and weather conditions. Some of the boats are also





used for leisure fishing and sea mammal observation, thus providing the boat company with an alternative source of income. The other boat operator is conducting leisure tours with fast Zodiacs and a visit to the wind farm is just one option out of many.

Local economy: The tours have contributed to local businesses – mainly boat tour operators and tour guides. It provides an alternative source of income for sectors in decline such as fishing, and it diversifies the local tourism offer. It is drawing tourists out of Copenhagen, thereby diversifying tourism geographically.

Many other human activities take place in the vicinity of the pilot site given the close proximity of the capital city. These include the tourism and recreation, local fishery, beach activities and diving.

Awareness raising: The educational and awareness raising elements of the tour have contributed to improve the understanding and knowledge about the role and importance of offshore wind for energy security in the context of the climate crisis. It generally allows discussions on how electricity could be produced, how a wind turbine works and the characteristics of an offshore environment. A wide range of visitors are also very curious to understand the Cooperative experience behind Middelgrunden; specifically on how it turned to minimize the rejection from local stakeholders and citizens during the design and construction phase of the windfarm. International visitors are particularly curious about Middelgrunden Windfarm Cooperative experience, and to further understand the details behind the Danish approach to involve citizens in offshore wind farm projects.

The tour has been offered to both locals and universities from abroad, as well as wind energy companies who use it for building their internal capacities and showcasing it to international clients and visitors.

2.1. Why a visiting program?

There is long time back tradition in Denmark that share/stakeholders of a wind turbine (both electricity producing and a mill for graining seed) can visit their turbine every year at the so-called “wind day” which is 3rd Sunday in June.

At Middelgrunden Wind we started this in 2002 and it was only allowed for share owners and their family. Soon, we learned that share owners often wanted to bring neighbours and friends with them, which we allowed. Slowly it was known by universities that there was an opportunity for getting up in the wind turbine more ad hoc.

In the board of the cooperative, we approved the idea of having a more structured visiting program, just the board decided as a condition that the organisation was placed in a company outside the cooperative and that closing down the turbine was compensated by a fee representing the loss of production. The assumption by the board was that a visiting program would be in line with the bylaws stating: “promoting wind energy”.

As the cooperative has no staff both guides and boats must be hired in.

2.2. Non profit

The basic idea behind the visiting program is that it has not to be giving profit for the cooperative. We pay the guides compensation for stepping out of their daily work and we pay the boat owners the fee they are using for similar tours.

From having a few tours a year up to 2011 the number of tours especially after the Fukushima Event in 2011 was increasing with visitors from Japan and South Korea as the power production was going from being centralized to be decentralised. Many delegations from provinces were visiting us to learn how we were organising the cooperative model of Middelgrunden.

Being involved in the UNITED project we started getting more organised as there was more focus on how other offshore Wind Farms could learn from us.

The number of visits during the last years is illustrated in Table 1.





Table 1: Number of tours, guests, and turnover (in kEUR) for the time period 2017 to 2023. In the period 2022-2023, 50% of the tours included climbing. In 2017 - 2019 only 30% were climbing.

Business	2017	2018	2019	2020	2021	2022	2023
Trips	31	35	48	4	13	75	90
Guests	676	930	1117	130	246	1687	1912
1.000 €	38,9	44,3	55,6	4,4	19,5	102,1	136,1

2.3. Stakeholders

In Deliverable 10.1 of the UNITED project the stakeholders has been identified as:

- The shareholders of Middelgrunden Wind Farm.
- SPOK ApS, the company organising tours on behalf of the cooperative board.
- Boat companies providing the boat to the tours.
- Visit Copenhagen, the Danish association promoting tourism in Denmark for citizens.
- Wonderful Copenhagen, Danish association promoting tourism in Copenhagen for citizens.
- State of Green, the Danish association promoting knowledge exchange and export of Danish companies to the world.
- The Danish wind turbine manufacturers like Vestas and Siemens Gamesa, who have shown interest in the tours we organise.
- The developers of offshore wind projects like CIP, Ørsted, Vattenfall, HOFOR represented by greenpowerdenmark.dk, who have shown interest in the tours giving potential customers an opportunity to study an offshore wind turbine close to Copenhagen.
- The museums/tall buildings from where the Middelgrunden offshore wind farm can be seen.
- Insurance companies
- The technical controller and maintenance company
- Divers, who eventually can also utilise the location of Middelgrunden Wind farm.
- All the visitors participating in both the offshore guided tours and seeing the virtual videos.

2.4. Disposition

This report presents the information needed to act as a guide by visiting the Middelgrunden Wind Farm.

The primary objective of this guide is to teach new guides how to behave. The manual is built up based on data dealing with different subjects and references to information material to be distributed to the visitors.

The secondary objective is to illustrate for potential operators of visits at other offshore windfarms what to be considered when starting a visiting program.





3. THE TYPE OF TOURS

The tours are organised as group tours, where the price is not based on the number of people, but on the size of the group, like:

- A Zodiac can only take 12 people.
- The larger boat (Sværd), which provides access to the foundation, can take maximum 30 people.
- There can maximum be 17 people in the nacelle.

The tour list can be found at Appendix 1. The following prices provided (currently calculated) include the price of the overall visit. To all prices VAT (150 DKK) must be added if invoiced to EU clients.

3.1. Simple tour

Recommended when the client just want to know about the project and to have a look by sailing around the farm. It is in total a 2-hour tour where the guide talks about the project and wind energy in Denmark; there are several boats we can use. Price 10,800 DKK. Same price up to 40 people.

A Zodiac (12 people) can also be used, but the Zodiac gives very limited time for talking. Duration 1 hours. Price 8,550 DKK.

3.2. Lecturing

Lecturing can take place in the client’s hotel, in the meeting room at SPOK’s office (limited to 18 people), in a meeting room rented by the Copenhagen Municipality (fee 375 DKK/hour) or at the Amager Strandpark (the beach from where the turbine can be seen).

3.3. Virtual visit

The virtual tour concept was developed during the COVID-19 period enabling people to visit the wind turbines from areas in Copenhagen where the turbines could be seen.

The visits are available at [Pilots-Denmark \(h2020united.eu\)](http://Pilots-Denmark (h2020united.eu))

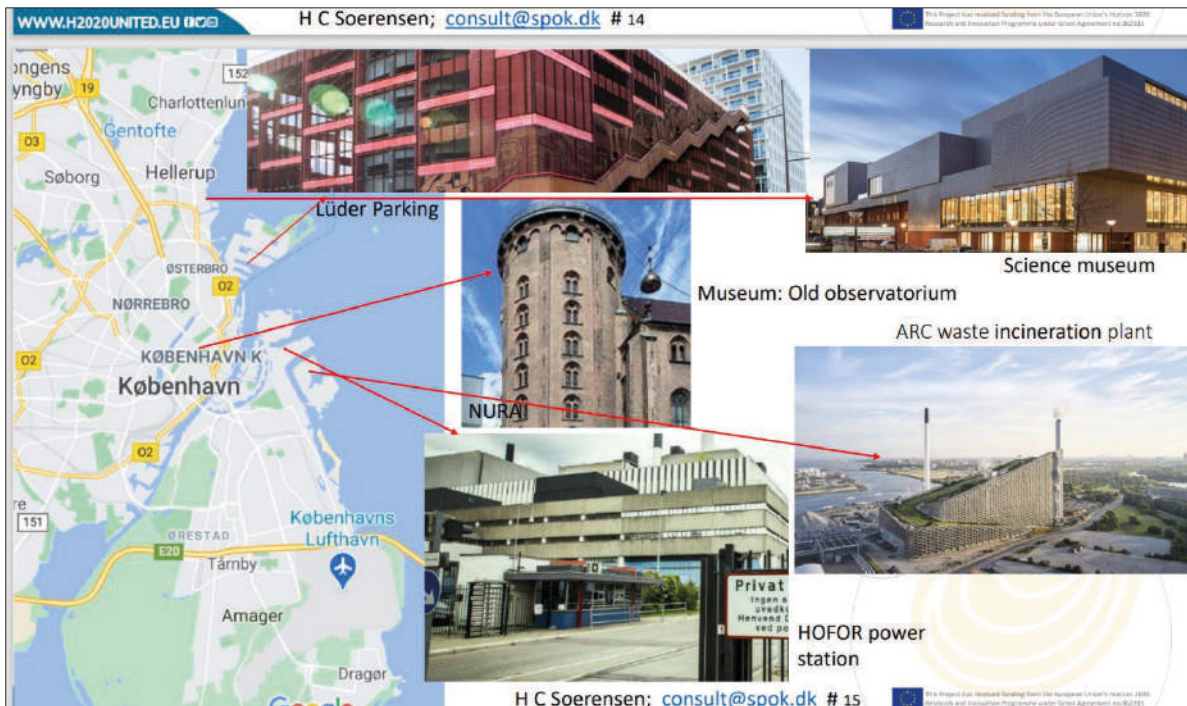


Figure: Potential sites to install the QR code giving access to the online virtual visits.





3.4. Visit the foundation

Recommended when the group wants to get up the foundation. There is one boat where it takes 2½ hours. The price is 11,800 DKK. Same price up to 20 people. From 21 to 30 people the price is 12.800 DKK, and the time is 3 hours. A low price and shorter time can be obtained using a Zodiac.

3.5. Climbing the turbine

Recommended when the group wants to get up the foundation and eventually climb to the top; there is one boat where it takes 2½-3 hours. The price is 16,400 DKK. Same price up to 17 people. A little higher price when the group is higher than 17 as this is the maximum we can have on the top. With up to 30 the price is 20,000 DKK and the time is 3½-4 hours.

If the group wishes to climb but does not have too much time, then a Zodiac can be used. The duration is 2 hours, and the price is 10550 DKK. Same price for up to 12 people. Please note the time for talking about the project is limited as we cannot talk during the sailing and only have ½-hour on top of the turbine. If you are up to 24 the price is double.

In general, note the risk of cancellation caused by weather is higher for trips using the zodiac as we must enter the turbine from the water surface.

In general, add 150 DKK in VAT to all tours.

By living in Copenhagen there is another opportunity as we are organising an open house on the 3rd Sunday in June. Each person pays 210 DKK if not being a shareholder.

3.6. How the visits are organised

Trip are asked for using the e-mail mollebesog@gmail.com alternatively by using the phone +45 28110219.

This mail and phone number are mentioned on the www.middelgrunden.dk.

Potential visitors then get the pricelist for the different tours.

For arranging a visit, it is important to know:

- Number of people
- Kind of visit climb/no climb
- Preferred date

After this information we can approach a guide and boat company.

Visitors can also book their tour by one of the two boat companies. They then ask for a guide.

When climbing the turbine, visitors must sign the “safety instruction”, look Appendix 8.

Using the Zodiacs visitors must sign a passenger list, look Appendix 9.

Departure sites:



Figure: Departure site Nordhavn





The SPAR boat company prefer Kalkbrænderihavnen where the boats usually are moored when not used. Departure or/and return can take place in the inner harbour area for an extra fee. If the client wants to depart or end after the bridges special attention has to be taken, as the bridges are not allowed to open during rush hours.

SPAR Shipping can provide food like sandwiches, snacks and coffee, soft water, and beer.

The Zodiac company is moored at Refshaleøen, which makes it easy to depart from places like Langelinie Kaj (Polar Beer), Nordre Toldbod or Ophelia Quay. If start or return is in the inner harbour, an extra fee is then charged.

Payment is asked for one week ahead.

The day ahead of a climb tour, the service provider for the wind farm is advised with a copy to the technical controller from the wind farm to coordinate service and visits. As more turbines can be used for the visit, there is usually no problem. Turbine M20 is as standard used when possible.



Figure Departure Langelinie Kaj



Figure: Departure Zodiac from Refshaleøen



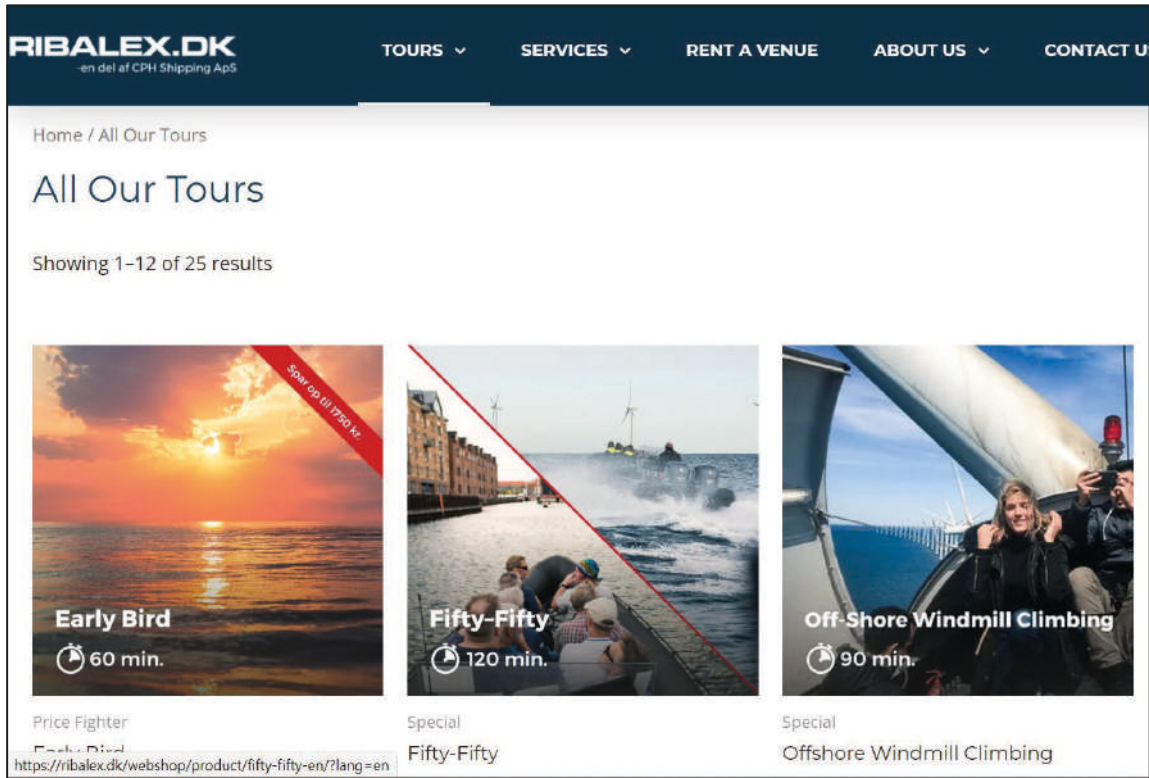


Figure: The Copenhagen Shipping is offering tours from their web site.





4. THE BOATS AND ACCESS

At present we are working with two boat companies: SPAR Shipping and CPH Shipping (RIB Alex).

Both companies are using their boats for other activities within the area of tourism/ transport of people. They therefore are certified by the Danish authorities and have an insurance related to this activity.

4.1. SPAR Shipping

The Ships we are using are moored at Kalkbrænderihavnen, Nordhavn,

There is only one boat that can get into the foundation, named "Sværd". This boat has a cabin under deck without windows. There is a front stair to get up on the foundation. The turbine foundation can be approached from 4 directions. The boat can take 30 passengers. The boat tour takes 40 min.

During the climb the boat is waiting 100 meters from the turbine.



Figure: SPAR shipping boat with front stair to reach the foundation and access point from boat to foundation.

The other boats are a little larger but cannot get closer than 50 meters to the foundation. They have a cabin at the deck level and can take up to 70 passengers. The price increases beyond 40 passengers.

One boat Bjørsholm (situated at Nyhavn) can take 140-170 passengers. Usually, it shall be booked for 3 hours minimum.





4.2. Zodiacs, RIB

CPH Shipping - RIB Alex offers boat tours mostly as Zodiacs (in Danish RIB Boats). A boat can take up to 12 passengers. It must moor at the foundation to the west only where the landing ladder is placed. Mooring at the sea level is more challenging as the waves and the current can be difficult around the foundation.

All sailing is with life vests. The company offers rain proof jackets in the summer period.

During the period from October to March the company offers waterproof suit (survival suit) which is a demand when the water temperature is lower than 10 C.

15 minutes must be allocated before sailing for dressing. The boat tour takes 10 min.

During a visit with climb the boats are going back to Copenhagen.

CPH Shipping will have a new type of boat from 2024 which can approach the foundation and carry 48 people.

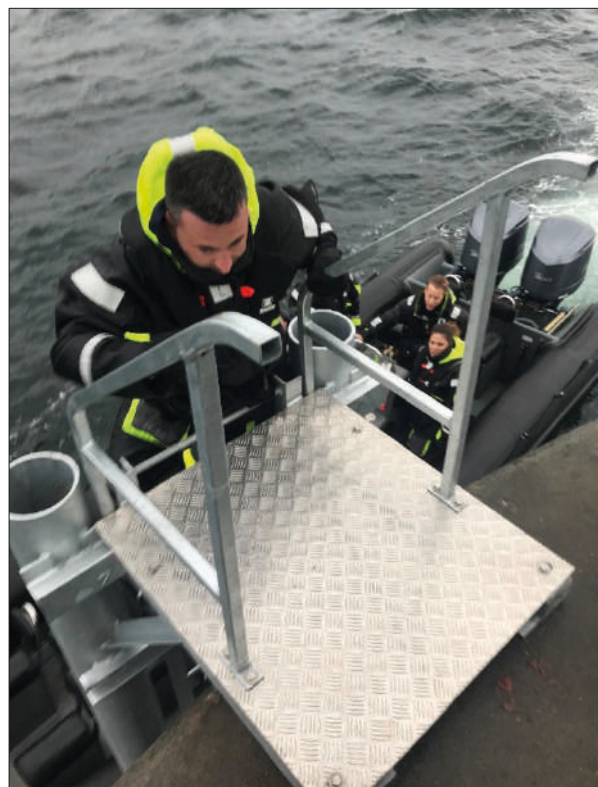


Figure: The Zodiac access to the turbine using the outer ladder to the west.





5. INFORMATION MATERIAL RELATED TO A VISIT

The following material is available for visitors in pdf format. The material is mentioned more formally in the reference chapter.

- *The Middelgrunden Offshore Wind Farm. A Popular Initiative.* 2003. 28 pp.
A general description of the Middelgrunde Wind Farm from start in 1996 to 2002.
- *Experience from Middelgunden 40 MW Offshore Wind Farm*, EWEA conference paper 2005, 8 pp.
A summary and some experience up to 2005
- *Middelgrunden, The beauty in the wind/ Danmarks Smukkeste Havmøllepark.* 2001. 60pp.
A book based on the photos taken during the construction, Danish and English text.
- *Experience With and Strategies for Public Involvement in Offshore Wind Projects.* EWEA special paper 2001. 4 pp.
A paper describing the process involving stakeholders.
- *Cooperatives – a local and democratic ownership to wind turbines.* Danish Turbine owners Association, 2009, 3pp.
Description of the Danish model for wind turbine ownership.
- *VVM redegørelse for vindmøllepark på Middelgrunden, 1999*, EMU & KMEK. 59 pp.
The EIA report including several separate reports. English summary.
- *Middelgrunden Wind.* Different ppt's .
With pictures from the construction, explanation about the cooperative model and trading wind on Nordpool.

5.1. The beginning of Middelgrunden: the cooperative and start-up project

The basic information can be found in [1] and [3].

1996 August	Inauguration of Lynetten Wind where a group of 6 people decided to propose Middelgrunden Wind farm.
September	Application Danish Energy Authority from the NGO and Københavns Energi.
October	Public meeting about the project for people that wanted to be involved, 50 people of which 25 disappeared when realising it was voluntary work.
December	Finance Bill with 5 M DKK grant for public participation in offshore wind.
1997 January	1 M DKK in Grant for studying “What could kill the project”.
May	Formally start of the cooperative.
1998 June	First proposal with 27 turbines each 1.5 MW in 3 rows, presented in a public hearing. More than 1,000 protests.
1999 June	Second proposal with 20 turbines each 2 MW in a curved line presented in a public hearing. Only 3 protests. <ul style="list-style-type: none"> ○ Swedish fishermen raised concerns about electromagnetic radiation from sea cables. Denied with reference to test at Nysted Offshore Wind Farm 2003. ○ Concerns from “Foreningen til Hovedstadens Forskønnelse” about the visual disturbance of old churches, towers, etc. Denied: too late already many high-rise buildings and power plants.





- o Mayors of the 2 municipalities north of the site where the richest people in Denmark are living (8 km from the farm). They were afraid of the drop in value of real estate for the bungalows along the beach. Denied with reference to information about impact from wind farms in Jylland with 4,000 turbines. Today people often include a picture of the wind farm when advertising the bungalows for sale.

5.2. Construction and first operational years of Middelgrunden Wind farm

1999 December Permission to build. Largest storm in history resulted in 10% increase in safety coefficients for offshore work. Must sell 22 mm steel plates and order 25 mm.

Decision on placing the lower part of the tower on the foundation in the drydock. The floating crane could take 100 t extra.

2000 April - Preparing the seabed, casting concrete in the drydock.

October Sailing out the foundation and start installation of the top tower and the nacelle with blades.

October All 40,500 shares sold for the 10 turbines after article in the Danish newspaper Jyllands Post.

November Placing sea cables.

December All turbines in production.

5.3. Environment Impact Assessment of Middelgrunden Wind Farm

The key problem was that the reef was an old deposit with contamination of heavy metals. Therefore, it was decided that all soft soil should be moved sideway to give space for foundation and sailing routes (see picture below). At the two positions outmost to the north there were more soft sediments than expected and more than could be moved sideways. A special permission was granted to transport the soft material to another position at the reef.

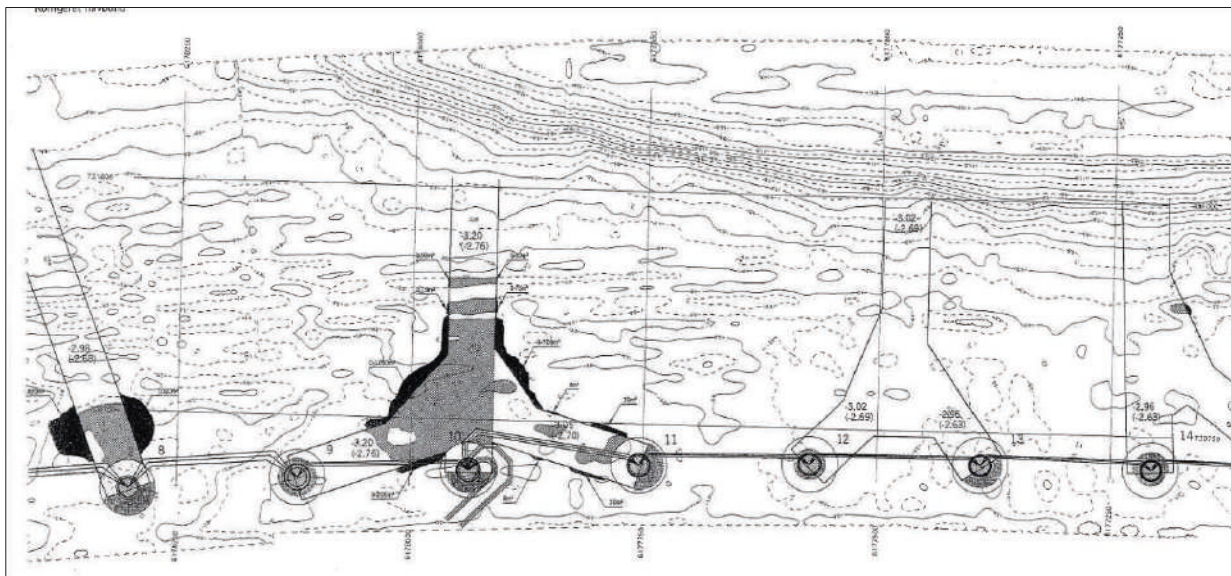


Figure: The turbines are situated on a natural reef in the Øresund. The reef has been used as dumpsite during the last 200 years. The floating crane transporting the foundation to their final destination has a draught of 2.3 m. The sea bottom is at some places only 2 to 3 meters under daily water level. Digging channels is necessary in order to get the foundation in place. The shaded areas are illustrating where sediment is removed or placed. Drawing by Carl Bo [3]





The visual impact was a problem when having proposed the 3 rows of turbine. People usually do not like a pattern they cannot recognise.

Birds are not a problem as few birds are passing the area.

Fishing is important. A study of the impact of destroying Eelgrass and Mussels was done upfront and after 1 and 3 years of operation. The fishing seems not to have been influenced in negative direction.

The fishermen were paid compensation for not fishing during the 9 months of construction.



Figure: Left: Diver bringing a fish to visiting fishermen and environmentalists from South Korea. Right: Fishing cod waiting for the first group to get down from the Nacelle.

5.4. Key numbers of Middelgrunden Wind Farm

Some key numbers to understand Middelgrunden Wind farm and of special interest to visitors is the following:

- Total Wind capacity: 40 MW
- 2 MW Bonus turbines * 20 turbines
- Owners: HOFOR (previous Ørsted/DONG Energy) & Middelgrunden Cooperative (8,500 people & 40,500 shares)
- Average wind speed: 7,2 m/s
- Capacity factor: 28,5%
- Production: 100 GWh/y; 3% of power consumption Copenhagen
- Total length of the park: 3,4 km
- Total area: about 1 hectare
- Blade tip height: 102 m
- Tower Height: 64 m





- Rotor diameter: 76 m
- Distance between turbines: 180 m
- Water depth: 3 to 8 m, depending on turbine.
- Planning and construction: 3 year and 4 months in planning, 9 months to construct.

5.5. The economy of Middelgrunden Wind Farm

- A share is 567 € equal to 1,000 kWh production a year.
- Simple pay back is 9.5 years.
- Dividend 11% in the first 12 years. Caused by no grants and low electricity price the dividend was 3-5% the following year up to 2022.

5.6. The repowering of Middelgrunden Wind Farm

- Hight limitation (115 m) caused by the airport result in keeping the turbine as they are even though calculations have shown a safety of 40% for the turning moment.
- Better air foil designed blades, could give 8% more power. But the feasibility is not justifying a new sea cable.
- Reports about lifetime extension for another 25 years has been established.
- Main changes are modernising of internet, sensor systems, SCADA etc.
- Replacing of gearboxes and main bearing when needed. 3 nacelles from 6-year-old turbines have been bought in The Netherland for repair.

5.7. Wind in Denmark

The development of wind energy in Denmark is very interesting to follow. The following representation provides a graphical representation of the evolution of wind power in Denmark since year 2000, where Middelgrunden wind farm was established as the first commercial offshore wind energy farm in the world in the MW-scale.

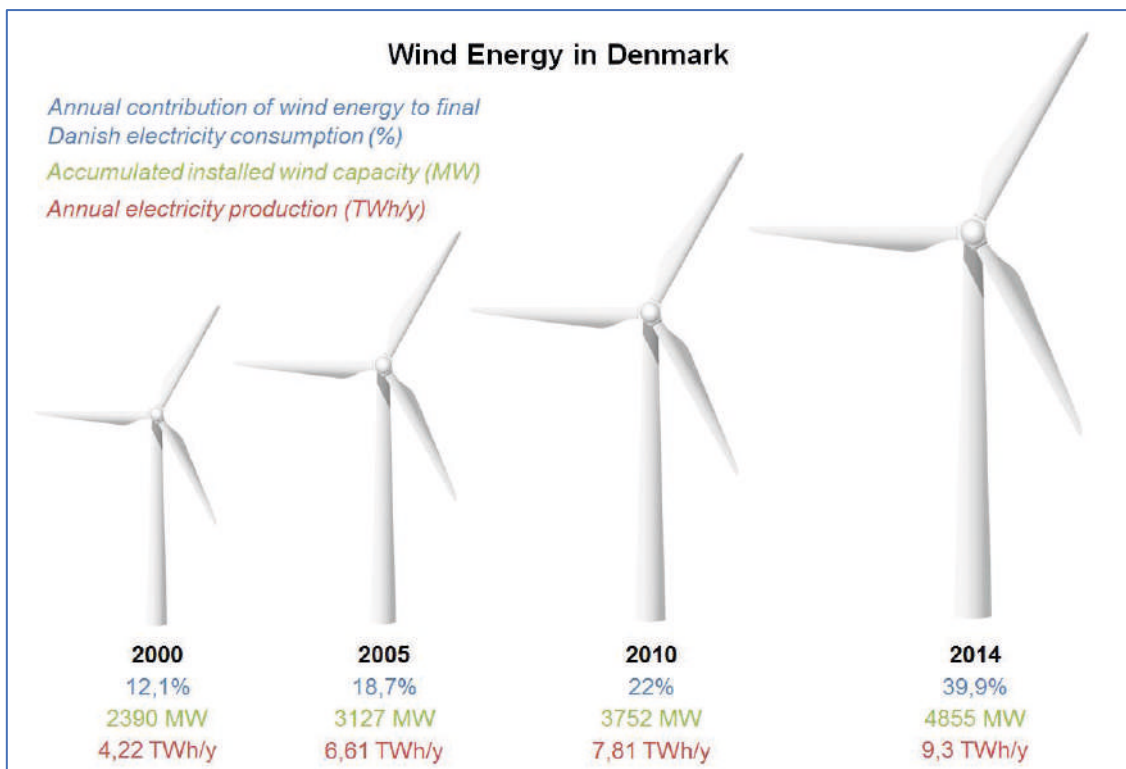


Figure: Evolution of Wind power in Denmark from year 2000 to 2014. Wind energy was covering 60% of the power in Denmark in 2022.





The present contribution of wind power and other energy sources to the Danish electricity mix can always be seen at www.energinet.dk, also showing the imports and exports of electricity from Denmark to abroad.

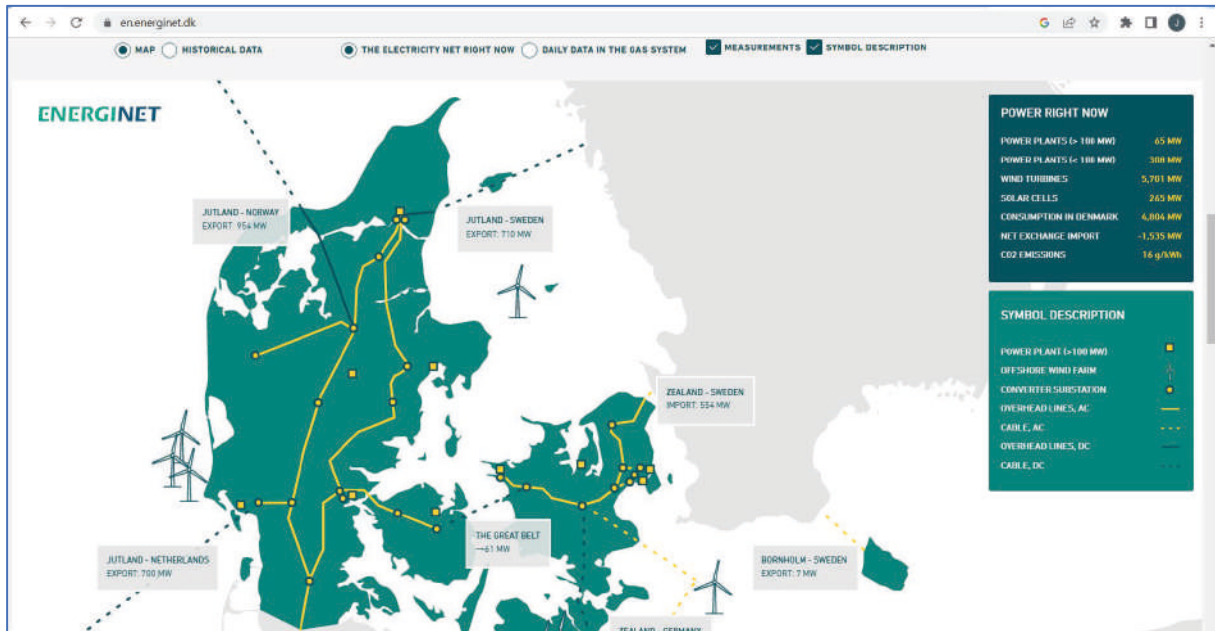


Figure: Energinet - Transmission system operator for electricity and gas in Denmark. "The energy system right now", (accessed October, 2023) <https://en.energinet.dk/>

The actual price of electricity paid to the producer can be found on [State of the Nordic Power System \(statnett.no\)](http://State of the Nordic Power System (statnett.no)) for the Nordpool area (Figure below).

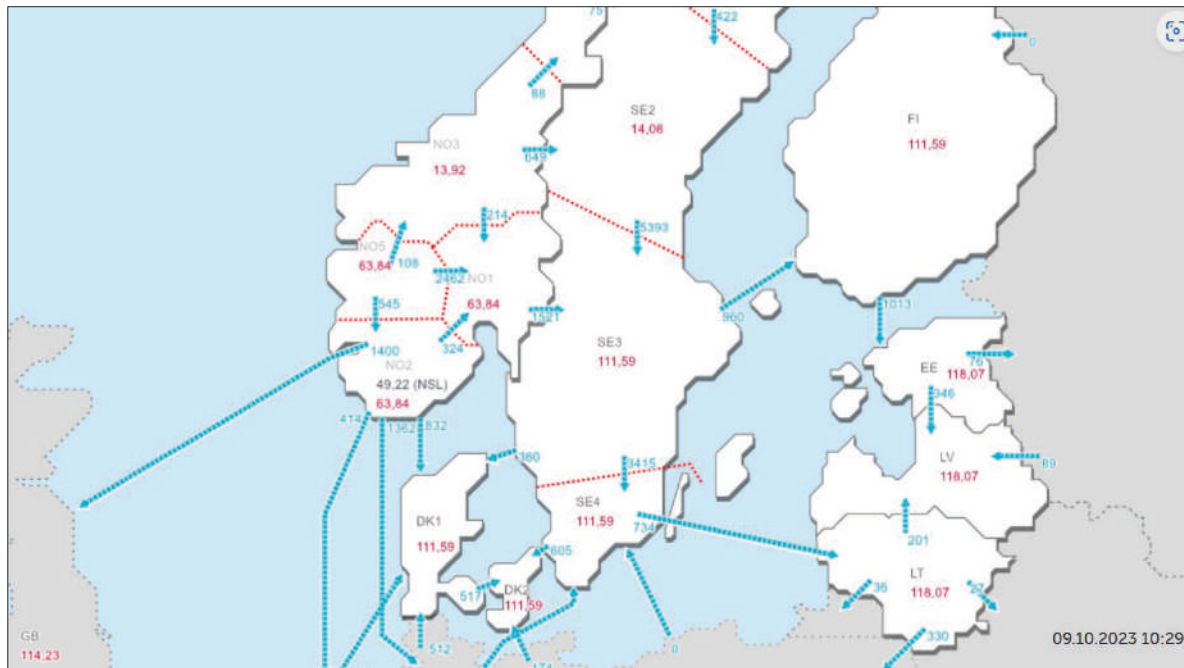


Figure: overview of electricity trading in the Nordic region on 09.10.2023 at 10.29. Accessed at <https://www.statnett.no/en/for-stakeholders-in-the-power-industry/data-from-the-power-system/#nordisk-kraftflyt>





5.8. Wind in Europe

Current facts and numbers of offshore wind in Europe provided by WindEurope (the trade association of the wind energy sector) are the following:

Europe's offshore wind
 32,430.MW connected to the grid
 6,166 turbines connected
 129 Wind Farms
 13 countries

With the following graph showing cumulative and annual offshore wind installations from 2010 to 2021

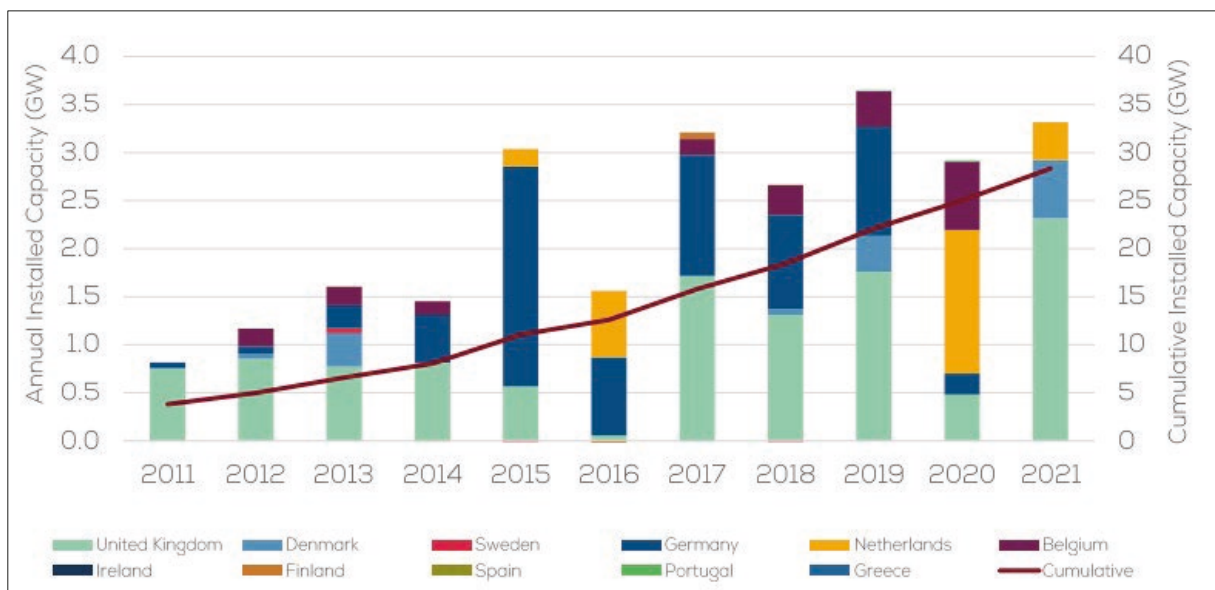


Figure: Cumulative and annual offshore wind installed capacity in Europe, source: WindEurope, <https://windeurope.org/policy/topics/offshore-wind-energy/>





6. THE TOWER, VISIT ON THE FOUNDATION

The tour usually starts with some generic facts about Middelgrunden wind farm, its layout, public engagement activities at its planning and construction time and the cooperative approach implementation.

As part of the visit it is also interesting to look around and see the surroundings of Middelgrunden wind farm:

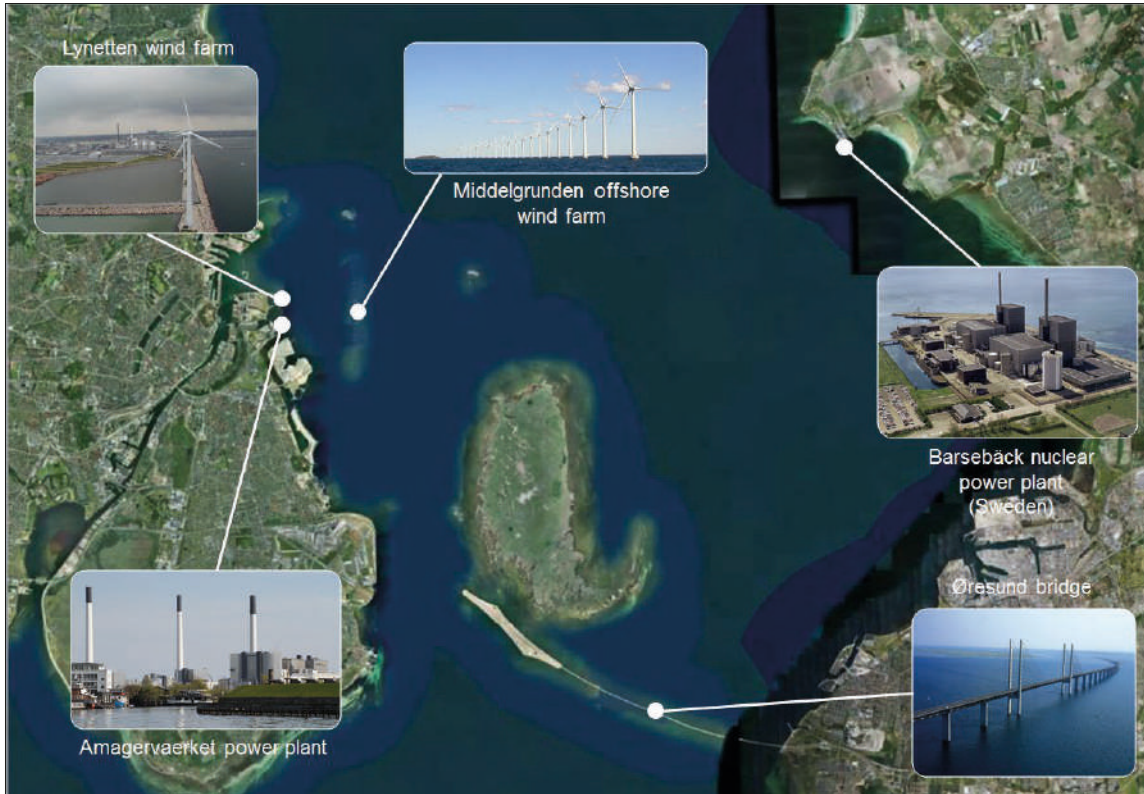


Figure: Viewpoints surrounding Middelgrunden offshore wind farm (source: Julia F. Chozas, www.juliafchozas.com)

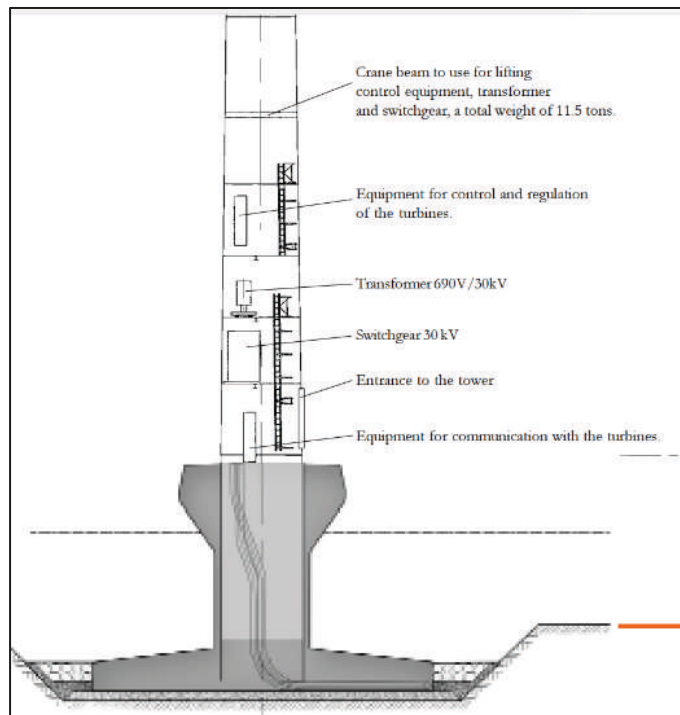
Other facts to explain in the tour:

6.1. Sea Cable

Explaining about the sea cable where the green thin cables are fibre optic communication cables ending in the unit at the floor.

6.2. High voltage breaker

In turbine number 20 (#20) the high voltage breaker (switchgear) is on the base floor. It is a second breaker which replaced the original breaker in 2016. The original breaker has been used for spare parts in #13 after a failure connected to the last break down of the step up transformers.





6.3. Step up transformer

Stepping up from 690 V produced in the Nacelle to 30 kV. Type dry type insulated by epoxy resin.

Distribution level in Copenhagen is 10 and 30 kV. The cable from #10 goes into the shore at Amagerværket and directly out to the consumers.

All transformers were designed to 2 MVA. All failed during the first 16 years. The first failing after only a few months production and was replaced by a new 2 MVA transformer which also failed.

Thereafter, all transformers were chosen at 2.5 MVA after which no failure occurred.

One explanation of the failures could be that during periods with southeastern wind the temperature was increasing to more than 105 C and we often had very stable production for several hours at full capacity 2 MW. We assume that micro cracks have appeared in the epoxy resin being brittle when the temperature is more than 105 C. Later on moist can show up in the microcracks and cause explosion.

At the design time it was standard to design for the capacity as the turbine. Later the standard has been changed so the design load is minimum 10% higher than the turbine capacity.

How to replace a transformer?

Replacing of a transformer is a complex job involving different work teams, special equipment: cranes, barges, boats, rails etc. all standard civil engineering equipment.

- The weight of a transformer is 6.2ton and it is placed on the 2nd floor inside the tower.
- Main manpower is provided for dismantling the floors inside the tower to make space for the transformer and for the installation.
- The transformer is split in 3 coils, and the outer door in the tower is opened.
- The average installation cost after optimisation have been reduced from 73,000€ to 47,000€
- The optimal working period has been reduced to 3 days.

6.4. The ladder system

Climbing is allowed without safety equipment when the ladders are not more than 8 meters high. Only one person is allowed on a ladder section.

Demonstrate at the zero level how you can relax leaning back to the tower. Explain that it is easiest to climb using the legs - not the arms.

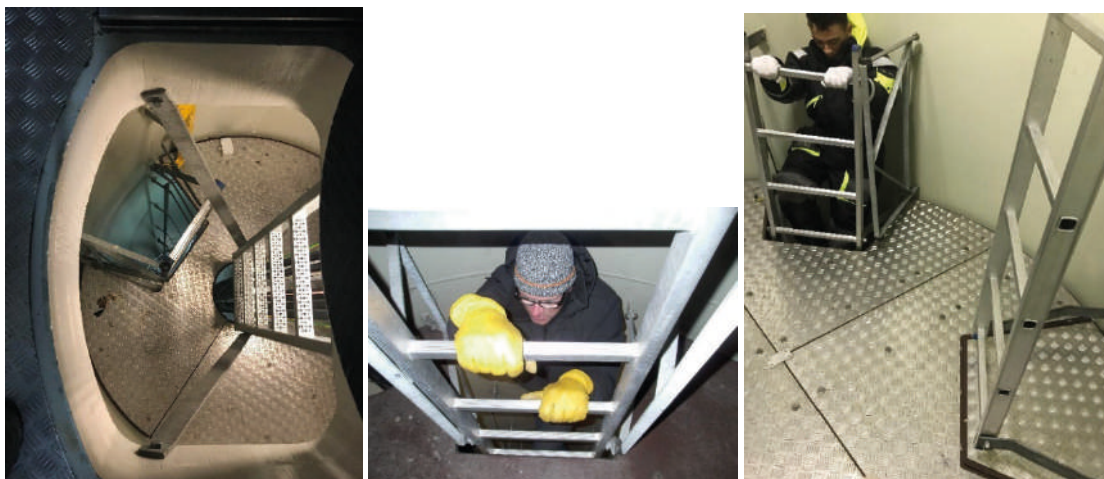
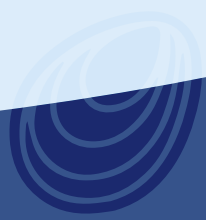


Figure: Ladder system inside one of the towers in Middelgrunden wind farm.





Basic to remember:

- Everything inside pockets + zips closed – nothing loose.
- Gloves for everyone.
- Check shoes – no slippers or high heels.
- Bring water.

6.5. The control system

Closing the turbine.

When getting to the control panel at the 3rd floor you first change from “remote control” to “local control”.

Then you open the door protecting the control panel.

Press E and use arrow to get to “production status”: you see the wind speed and power produced.

Press “stop” and you hear and feel that the turbine is stopping production.

IT IS NOT ALLOWED TO ENTER THE TURBINE WHEN PRODUCING – if entering during production all need to have passed a safety course and all need to use special safety belts to be able to repel down outside in case of fire.

Take out the control panel you may need it up in the Nacelle.

Starting the turbine.

Place the control panel connected to the multi plug.

Press ESC and use arrow to get to “failure mode”. Press E. Is usually showing “manual stop”.

Press .0 (point zero).

Look at the failure mode. If “system fejlfrt” you can start the turbine pressing START. A light noise can be heard.

Close the cabinet door.

Move to remote control.

Climb down.

Remember to shut down for the light.

Leave the turbine.

Close the door and lock with your key.

If not working

If you get a “new failure mode” which could be a lot of different types, you can only do something:

- if it is manual stop – then try again.
- if it is “nødstop” (“emergency stop”) you must go up in the Nacelle again. Look for what to do in Appendix 6. Remember the control panel. – if by any mistake the “emergency stop” at the main panel has been pressed – look figure - can be reset following the standard procedure used in the Nacelle.
- If it is something like “pressostat..., break ...” give up.

Just remember to move to remote control and to give a message to the service people.

Contacts:

- Service people: Jesper Kempel, jesper.kempel@connectedwind.com; phone +45
- Middelgrunden technical support: Lars B. Jørgensen, lj@conwind.dk; phone + 45





Figure: Control system panel with remote control.





7. THE NACELLE

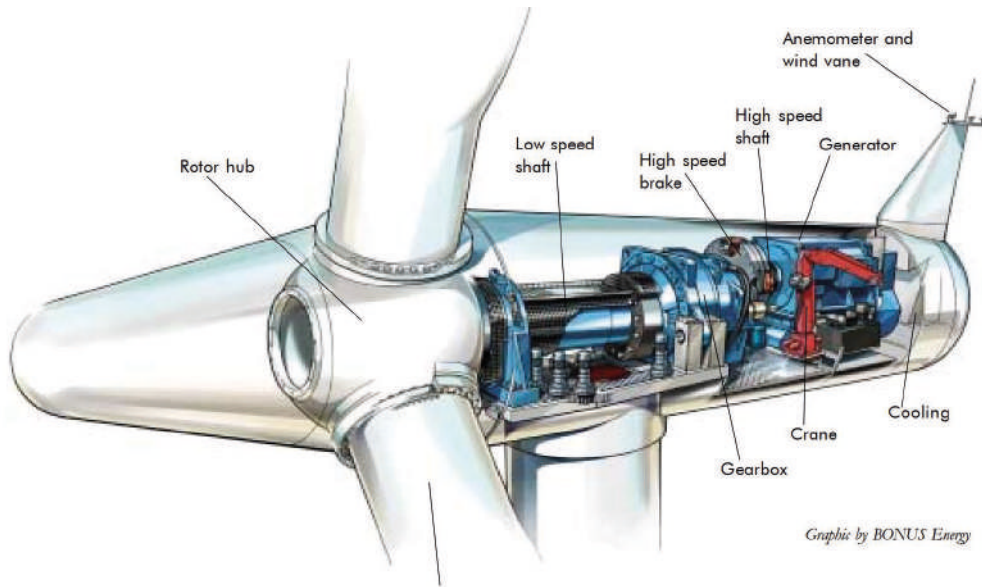


Figure: Nacelle equipment in the Middelgrunden Wind Turbine [1]

7.1. Entering

Getting to the last small ladder you must slide the hatch to get up in the Nacelle, see Figure below.

Help people to find their way up the last ladder, which can be a little difficult for short people. It can be helpful to lean your back against the wall to reach the handle over the hatch and avoid banging the head up in the handle. Be aware that the hatch is not fixed, so better avoid holding on to it.

If the wind is in SW direction, the last ladder is directly in extension of the previous ladder, be aware.

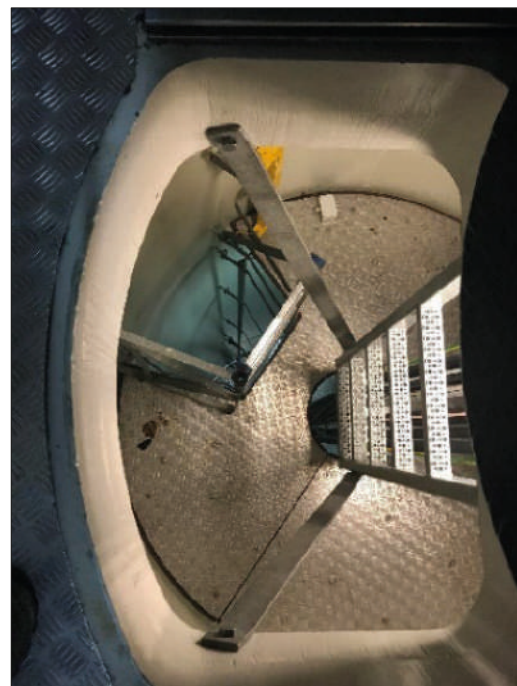


Figure: To the left: at the top the hatch to the Nacelle to be slid in direction of the centre of the turbine tower. To the right to last short ladder.





7.2. Opening the hatches

Firstly, release the two manual locks.



Figure: Location of the two manual locks inside the nacelle.

Then, press the white bottom (where the grey arrow on the figure below is pointing at) and pull handle number 1. Thereafter continue pressing the white bottom and pull handle number 2.



Figure: The handles to be used when opening the two hatches





Figure: the right hatch is open. Note the mechanical lock system to be opened before opening and locked after closing.

7.3. Opening the top hatch

Close to the blades a small hatch can be opened by moving 4 finger screws.



Figure: opening lock to the blades and the small hatch to be opened for a better view when the wind is not in SW.





Be aware that people should not climb higher than when standing on the main shaft cover. Avoid leaning out, using its tiptoe or arms to reach a higher view.

Depending on the wind direction it is a good idea to open this hatch as from here the whole line of turbines can be seen.

7.4. Emergency stop

If the emergency stops are activated the power is stopped in the Nacelle. It is easily detected as the rather noisy compressor used for among other things closing and opening the two hatches are stopped.

You can start immediately to reset the control panel or wait to the end of the visit. For more information look at the Appendix 3 and 6.

7.5. Where to stay

In the Nacelle you can stay anywhere within the fences created by the hatches and the wires.

Be aware that people don't try to climb outside the top of the Nacelle and to lean out when using the opening created by opening the small hatch.





8. WEATHER RESTRICTIONS

It is not possible to visit the turbines (on the foundation or in the Nacelle when thunder. Look at Appendix 4.

Visits by boat only is possible.

If the wind speed is too high typical 15 m/sec but it depends on the boat and the wind direction. It is not nice to travel by the boats and the captains typically is cancelling as too many will be seasick.

Using Zodiac the risk of cancelling is a more complicated as the Zodiac only can approach the foundation from the west. Therefor a combination of wind direction and current is essential. The decision is again up to the boat captain.

In general wind from north, northeast and south is giving higher risk for cancelling.





9. ACCIDENTS

At the nacelle you find the emergency kit, called “Nødhjælpkasse” – a box with basic needs for helping by small accidents.

If you need external assistance, you should call 112 and ask for “Beredskabsstyrelsen”.

9.1. An example

We have only had one serious event during the visits. This took place 17th June 2023 during the open house and is illustrated below.

A middle-aged women felt dizzy when getting up the floor 7.

She decided to rest on the floor and fainted just before she sat down. She twisted her leg (turned out later than a small bone was broken).

We called 112 and the “Beredskabsstyrelsen” came out with a sea ambulance (see picture) and 5-6 people.

The tried to help her getting down the ladders but she could not use her leg. She was then fixed on a stretcher, and they brought the stretcher down.

This was a problem in the beginning as the people did not know that the hatch (look picture) in line with the ladders could be removed so there was an opening all the way down.

The total operation lasted 3 hours. A bit longer than expected but the “Beredskabsstyrelsen” used it also as a training.

During the rescue operation the people already in the nacelle was trapped as no one was allowed passing during the operation.

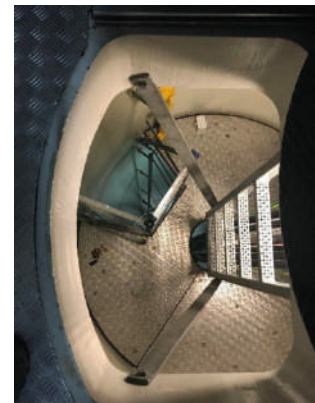
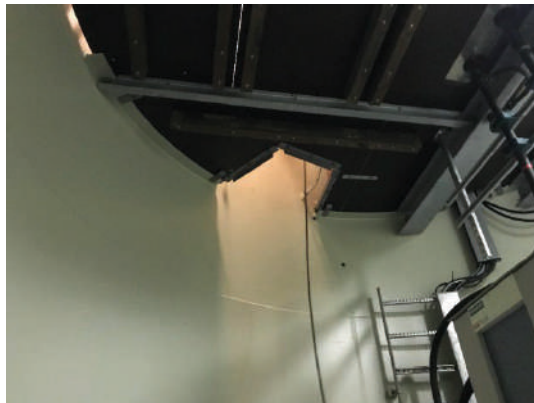
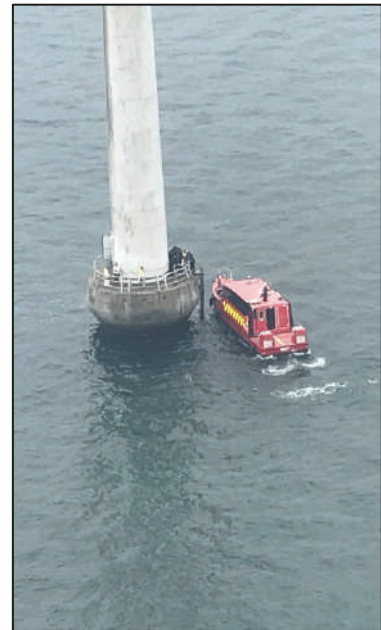


Figure: To the left: the hatch in line with the ladder inside the wind turbine tower. To the right: the opening all the way down after removing the hatch.

A special difficult part of the operation was to bring the stretcher from the foundation to the sea ambulance as the ambulance was not a large boat. It was surging and moving up and down caused by the waves. The boat we are using for visits are approaching the foundation at its front where if get “fixed” using it power. This method makes it much easier to enter the turbine than what was possible using the ambulance. Alone this operation took 1 hour.

Another problem we observed was the communication between the people in the turbine and the people on the boats are very difficult using mobile phone as the steel tower is stopping the phone signal.





The conclusion from this event was:

- Find a solution for communication.
- Place a small chair on each floor to make rest easy.
- Place instruction for Beredskabsstyrelsen so they know how to get the stretcher down opening hatches.
- Consider having a heat starter (defibrillator) in each turbine during large visits.
- Make sure there is water supply during large visits.

9.2. Insurance

Whereas the boat operator has an insurance covering the period they are transporting the client from the harbour to the turbine, the tour guide (tour operator) insurance comes into play from the moment the client leaves the boat through the ladder and access the foundation, and vice-versa.

The insurance for the guides is covering all visitors also. When climbing it is a condition that the visitors has signed the “safety instruction”, look Appendix 8.





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APPENDIX 1 TOUR PROGRAM

SPOK ApS



Sustainable Projects - Offshore Know-how

Middegrunden Wind Farm 2023.v7-

We are organizing visits in more ways. Please note that we must bill you for the hours and cost used, as we in our wind farm organization have no employees or service boats. The Guides must take off hours from their daily work and we have to hire in a boat for transportation.

Individuals are - if possible - invited to join a group trip for a fee of 210 DKK.

Cancelling: can take place with short notice if caused by weather or break down of the boat. Prepayment will be refunded. No refunding of other kinds will take place. Cancelling by weather conditions is typically caused by lightning (for trips climbing the turbine) or by too high wind/wave by trips using the RIB boats.

Physical conditions: climbing the ladders outside the foundation (from RIB/Zodiac) and inside the tower to 64 meters height is challenging. *People not used to climb a ladder may be exhausted.*

General condition: look down.

A) A simple boat trip around the turbines.

Up to 70 people.

Departure from Nordhavn (10-15 min's walk from Nordhavn S-train or Metro station). Extra price if departure from the City. Boat trip duration 1½-2 hours depending on weather. Explanation about the project, ownership structure etc. We get 100 meters from the turbine. If times permits: A presentation about the Danish Cooperative way, we have used establishing the 4 large wind farms in Copenhagen. Q&A session about wind and energy policy in Denmark

Price

Guide (guide HC Soerensen, PhD, board member) on the boat.....3,200 DKK
 Boat.....7,000 DKK if more than 40 people 8,500 DKK
 Adm. Fee.....600 DKK

In total 10,800 DKK; if 40 -70 people: 12,300 DKK. Danish VAT is 150 DKK.

When more than 70 people: 19.800 DKK. Departure Nyhavn. Danish VAT is 150 DKK.

EU groups must add 150 DKK (VAT) if not having valid VAT registration number (reverse charge).

B1) simple boat trip entering the foundation. *Maximum 30 people on the boat.*

Departure from Nordhavn (10-15 min's walk from Nordhavn S-train or Metro station).

Boat trip duration 2 - 3 hours depending on weather. Explanation about the project, ownership structure etc. If the weather permits only, we enter the turbine foundation.

If times permits: A presentation about the Danish Cooperative way, we have used establishing the 4 large wind farms in Copenhagen. Q&A session about wind and energy policy in Denmark

Price

Guide (guide HC Soerensen, PhD, board member) on the boat.....3,200 DKK
 Boat..... 8 - 9,000 DKK (2½/3 hours)
 Adm. Fee..... 600 DKK

In total 11,800/12,800 DKK 20/30 people, 2½/3 hours. Higher price can be expected during the winter period if the boat is not in the Copenhagen area. Danish VAT is 150 DKK.

EU groups must add 150 DKK (VAT) if not having valid VAT registration number (reverse charge).

B2) simple boat trip entering the foundation *Maximum 12 people on the boat.*

Departure from Refshaleøen or Langelinie (RIB boat).

Boat trip duration 1½-2 hours depending on weather. Explanation about the project, ownership structure etc. If the weather permits only, we enter the turbine foundation.

If times permits: Q&A session about wind and energy policy in Denmark

Price

Guide (guide HC Soerensen, PhD, board member) on the boat..... 3,200 DKK
 RIB boat..... 4,750 DKK
 Adm. Fee..... 600 DKK

In total 8,550 DKK. Danish VAT is 150 DKK.

EU groups must add 150 DKK (VAT) if not having valid VAT registration number (reverse charge).

This trip can be prolonged with ½ hours sightseeing in the harbor area for 1,250 DKK.

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CVR#: 25 04 21 82
 www.spok.dk

SPOK ApS
 Frederiksborggade 1 – 4tv
 DK-1360 Copenhagen K

Mobile: +45 2811 0219

E-mail: consult@spok.dk





SPOK ApS

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June 2022

C) Lecturer on the beach looking to the turbines.

1½ hours presentation at the Amager Strand (beach) at Pier 5. Meeting can be Femøren Metro Station. Information about the project, layout, design and experience. Basic information about the Danish energy policy including Q&A session with focus on wind.

Price

Lecturer (HC Soerensen, PhD, board member) 1½ hour..... 3,000 DKK
In total 3,000 DKK. No VAT.

D) Boat trip and lecture

1½ - 2 hours presentation at the central Copenhagen in a meeting room (up to 20 persons - Center of Copenhagen, Frederiksborggade 1, 1360 or at a meeting room at your hotel or similar, where we may have to pay another rent). Information about the project, layout, design and experience. Basic information about the Danish energy policy including Q&A session with focus on wind. ppt copy included.

Price Lecture

Lecturer (HC Soerensen, PhD, board member) 1½ - 2 hour..... 2,400 DKK - 3,200 DKK
Meeting room..... 800 DKK
Adm. Fee..... 600 DKK

In total 3,800 to 4,600 DKK. Danish VAT is 150 DKK.

EU groups must add 150 DKK (VAT) if not having valid VAT registration number (reverse charge).

Include 1½ - 2 - 2½ hours boat trip: add price **A)** or **B)**, and save 600 DKK

Price of transfer to harbor (Your coach or by public transport) taking about 30 minutes is not included.

E) A Boat trip including climbing the turbine

Boat trips B1-B3 is used depending of the number of people. With more than 17 people the duration is longer as we only can be maximum 17 in the Nacelle and the trip must be in two steps and the price higher.

When getting to the turbines we climb one of the turbines and open the Nacelle.

Duration 2 - 3½ hours.

Departure from Nordhavn or Refshaleøen/Langelinie dependent of the boat selected B1/B2/B3.

Explanation about the project, ownership structure etc. During the boat trip a presentation about the (Danish COOP) way we have used establishing the 4 large wind farms in Copenhagen. Q&A session about wind and energy policy in Denmark.

Price On top of the boat trip B1-B2

Guide (guide HC Soerensen, PhD, board member) ½ -1 hours800 - 1,600 DKK
Boat waiting fee 1 hours2,000 DKK
Compensation one hour for stopping production.....1,000 DKK

In total 4,600 DKK on top of the price for Boat trip B1. In total 2,000 DKK on top of the price for Boat trip B2.

If you are more than 17 people, the price is based on 30 people and will in total be 20.000 DKK; duration 4 hours. Danish VAT is 150 DKK.

EU groups must add 150 DKK (VAT) if not having valid VAT registration number (reverse charge).

General conditions

The tours usually can start after negotiation.

Get off and on in the harbor area is possible but cost extra as the boat trip is much longer. Typical 1,500 DKK.

Payment one week ahead of the departure.

Cancelling possible up to one week ahead without fee. If money has to be returned, you pay the bank transfer.

The captain can cancel climbing up the turbines without notice depending on the actual weather situation.

Access to the turbines is not allowed during thunder (up to 70 km's away).

The guide can be replaced without notice but only with an experienced other guide.

The pricelist is valid 2023 v7-, June 2023; the boat prices can be changed with short notice but is fixed after ordering the trip.

Hans Chr. Sørensen

SPOK ApS and board member of the Middelgrunden Wind.

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Mobile: +45 2811 0219

E-mail://consult@spok.dk
Http://www.spok.dk

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DK-1360 Copenhagen K

X





APPENDIX 2 HEAD SET

Vejledning i brug af Headset.

Rækkevidden er stor nok til at dække hele skibet.

1. Hvert sæt har en grøn afbryder i bunden.
2. På siden findes en grøn omskifter til kanal 1, 2 og 3 (svag blå, rød og grøn farve i headset) viser sig, når man har tændt.
3. Normal er indstillet ved start til kanal 1, blå farve
4. Antenneboks tændes på midtstilling (sparer strøm) LAMPE LYSER RØDT
5. Bag på antenneboks kan man se hvilken kanal, der er anvendt. Hvis ikke der står 1 trykke nogle gange på hvid knap.
6. Modtage mikrofon med rød ledning sættes ind i MIC. Tænder automatisk, når antenne er tændt.
7. Mikrofonen, man taler i, sættes på skjorte/bluse ved halsen. Skal først tændes ved at man presser et sekund eller 2 på Ø til den lyser blåt. Slukkes på tilsvarende måde, når man ikke længere vil tale. Er lidt følsom for vind, så man skal helst stå med mikrofonen i læ. Man kan hold den i hånden.
8. Når man slutter, bedes folk slukke for Headset og aflevere det; hvis det ikke regner, lægger jeg dem på bordet foran styrehuset.
9. Man slukker på 4, når man ikke vil tale mere.





APPENDIX 3 CONTROL SYSTEM IN THE NACELLE

The connection to the turbine for the control system in the Nacelle



Figure: The multicable is connected under the box to the right

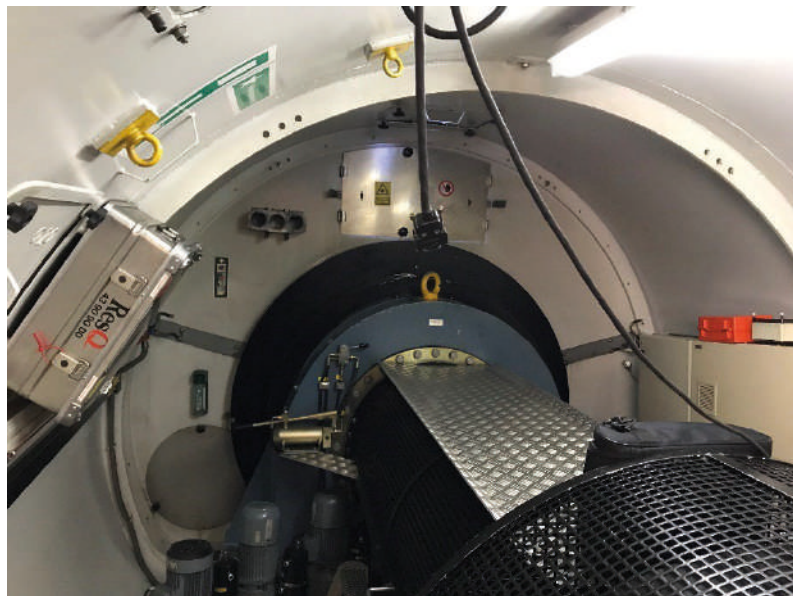


Figure: A multicable is normally placed at the top like here, which makes it easy to connect the control panel





APPENDIX 4 THUNDER

It is recommended to use an app showing lightning, like DMI.

FORHOLDSREGLER VED TORDENVEJR

I tilfælde af tordenvejr, skal møllerne forlades. Hvis dette ikke kan ske rettidigt, skal personerne på møllen opholde sig i bunden af mølletårnet, uden at berøre tårnet og kontakte byggepladslederen for nærmere direktiver.

- Arbejde i vindmøllen skal afbrydes, når der kan ses lyn, men ikke høres torden, idet tordenvejret da vil være inden for afstanden 10-30 km. Møllen kan forlades, så længe det vurderes, at tordenvejret endnu ikke er tæt på – se pkt. 2.
- Arbejde i vindmøllen skal afbrydes umiddelbart, når der kan høres torden, idet tordenvejret da vil være tæt på og inden for afstanden 0 – 15 km. Personen skal umiddelbart gå til et sikkert sted i møllen og blive der indtil tordenvejret er drevet over. (Se tegning)
- Tordenvejret kan anses for at være drevet over, når der ikke længere ses lyn og der er gået 15 minutter siden torden sidst blev hørt.

Hvilke områder skal forlades og hvor kan personerne opholde sig sikkert ?

På følgende tegninger er vist med røde figurer, hvilke områder personen ikke må opholde sig i under tordenvejr, disse områder skal altid forlades under tordenvejr. Med grønne figurer er vist, hvor personerne kan opholde sig sikkert under tordenvejr.

Generelt vil platforme i tårnet være sikre steder for personen at opholde sig, (undtagen ud for krøjelejet). Personen kan stå eller sidde på platformen, men skal holde sig ca. ½ meter fra væggen og fra i tårnet lodretgående metaldele, som f.eks. stiger, wirer og kabler.

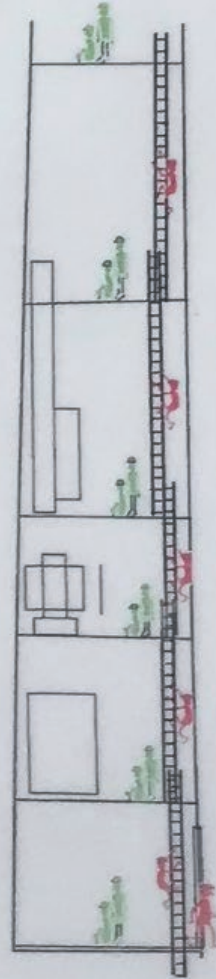
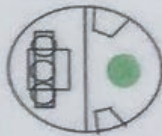
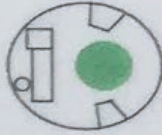
Platforme, hvor der er skabe med installationer eller hvor der er transformere, koblingsanlæg og lignende, anses for sikre, forudsat at skabe er lukkede og transformere, koblingsanlæg og lignende er i normal tilstand – og ikke f.eks. adskilt.

Generelt vil det være sikkert, at opholde sig inde i en båd af metal og med metallisk overdækning.





FORHOLDSREGLER VED TORDENVEJR.
 Hvilke områder skal forlades : **RØD MAND**
 Hvilke områder er sikre : **GRØN MAND**



1





APPENDIX 5 ACCIDENTS

In case of an accident, you must call 112. It can be difficult to log-on the phone to a Danish internet, as the phone automatically find a Swedish provider. Try with +45 112.

Uheld

Servicebåden, Føniks.....	Telefon <u>43436767/51580994</u>
Siemens Windpower A/S.....	<u>99422480</u>
Dong Energy.....	<u>99556666</u>
Dong Energy, Netcenter	<u>72104800</u>

Alarm

Alarmcentralen.....	112
Søværnets	<u>89433099</u>
Operative Kommando, SOK	
Politi	<u>33141448</u>
	<u>Lok. 2130</u>

Lås mobil til dansk udbyder, idet opkald ellers kan ske til Sverige

X: Alarm 0: information

Mand over bord	Brand	Arbejdsulykke - evakuering	Dødsfald (Ikke p.g.a. ulykke)	Akut sygdom - evakuering	Dykkersyge	Kollisions fare	Drivende skib	Bombetrussel, sabotage etc.	Hvem skal alarmeres/informeres?
X	X	X	X	X	X			0	Alarmcentralen 112
0	0	0	0	0	0	X	X	0	Søværnets Operative Kommando SOK
0	0	0	0					X	Politiet





APPENDIX 6 EMERGENCY STOP

When activating one of the 3 emergency stops in the Nacelle you realise it immediately as the noisy compressor stops. The red and blue stop buttons can be reset by drawing or pulling them. They are not necessary working in the same way.



Figure: the emergency stop (red) for the crane can easily be activated just by leaning back without realising it.





Figure: The basic emergency stops (two blue bottoms) are connected to the red wires following the Nacelle hatch. If stepping up on the hatches it is easy to put a foot on the line and activate the emergency stop.

Resetting the control system after activation of the emergency stop.

Push the two blue bottoms. Check by pulling the red line and observe how the bottom is getting out.

Connect the control panel to the multi plug wire look Appendix 3.

Pres ESC and use arrow to get to “failure mode”. Press E. Is usually showing “emergency stop”.

Pres .0 (point zero).

Look at the failure mode. If it shows only “manual stop” you can again use the systems by closing the hatches. Then, a noise can be heard from the compressor.

If this is not possible, look again at failure mode. Repeat eventually the procedure when showing emergency stop. Check also the emergency stop at the crane. It must be reset by pushing it in.





APPENDIX 7 CUSTOMER SATISFACTORY SURVEY

H2020UNITED.EU

UNITED Danish pilot - Tour of the wind farm

Customer satisfaction survey

This survey will allow us to assess customer satisfaction with the boat tour to the wind farm and collect recommendations for future tours. In this way, we aim to improve our service. Thank you for your collaboration.

How did you hear about the boat tour to the wind farm? (Please select all that apply) *

Online search
 Word of mouth
 Social media

What is your role in relation to this tour? *

People attending (specify how many)
 People organising the excursion (specify how many)

On a scale of 1-10, how satisfied were you with the overall booking procedure? 1 being extremely frustrated and 10 being extremely satisfied. *

<input type="checkbox"/> 1	<input type="checkbox"/> 6
<input type="checkbox"/> 2	<input type="checkbox"/> 7
<input type="checkbox"/> 3	<input type="checkbox"/> 8
<input type="checkbox"/> 4	<input type="checkbox"/> 9
<input type="checkbox"/> 5	<input type="checkbox"/> 10

On a scale of 1-10, how satisfied were you with the overall tour experience? 1 being extremely frustrated and 10 being extremely satisfied. *

<input type="checkbox"/> 1	<input type="checkbox"/> 6
<input type="checkbox"/> 2	<input type="checkbox"/> 7
<input type="checkbox"/> 3	<input type="checkbox"/> 8
<input type="checkbox"/> 4	<input type="checkbox"/> 9
<input type="checkbox"/> 5	<input type="checkbox"/> 10

Were the tour guides knowledgeable and informative? *

yes
 no
 N/A

Was the duration of the tour appropriate? *

yes
 no
 N/A

Did you receive appropriate and relevant information before and during the tour? *

yes
 no
 N/A

Were there any specific highlights of the tour that you particularly enjoyed? (Please select all that apply) *

Visiting a wind turbine
 View of the wind farm
 Educational aspect of the tour
 Background information provided
 The boat and offshore experience

Were there any areas of the tour that you feel could be improved upon? (Please select all that apply) *

Background information
 Transport by boat
 Tour guide
 Duration of the tour
 Level of explanations during the tour

Would you recommend this tour to others? *

yes
 no
 N/A

Do you have any additional comments or recommendations for future tours?

Consent to data collection by event organisers *

By checking this box, you submit your information. This information will be stored on our server and deleted after 3 years. It will not be used to other purposes.

SCAN ME

Alternatively, enter the following URL:
<https://form.jotform.com/230092603258350>

Subscribe to the UNITED newsletter to stay up-to-date on latest updates:
<https://www.h2020united.eu/newsletter>

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement no 862915

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APPENDIX 8 SAFTY INSTRUCTION

This instruction must be signed by all climbing the turbine (Danish and English version)



Underskriftserklæring for besøg i Middelgrundens vindmøller 2020 -

Turen ud til møllerne og klatreturen op i dem, er både en fysisk udfordring og en oplevelse ud over det sædvanlige, men det også er en praktisk og sikkerhedsmæssig udfordring. Derfor er det strengt nødvendigt, at samtlige gæster læser denne erklæring grundigt og erklærer sig indforståede med de nævnte betingelser og forholdsregler. Personer under 18 år kan kun deltage i følge med den forælder/lærer, der skal stå som underskriver nedenfor. Denne erklæring indgår som en del af laugets beredskabsplan.

Ved opstigning i møllen kræves det at:

- jeg ikke er påvirket af alkohol, medicin, eller narkotika,
- jeg ikke lider af klaustrofobi eller højdeskræk,
- jeg ikke lider af kredsløbsforstyrrelser, svimmelhed, epilepsi, el.lign. og at,
- jeg er i god fysisk form og ikke væsentligt bevægelsehæmmet.

Jeg skal være opmærksom på de afmærkninger, der er opsat forskellige steder i møllen og respektere de anvisninger, der gives af guider og personale. I møllerne gælder det, at der kun må være en person på hver stige, højst tre personer på hver etage (der er 11 etager) og højst 18 personer oppe i møllehatten.

For at sikre en jævn gennemstrømning af gæster i møllen, er det vigtigt at de hurtigste gæster klatrer først op, men samtidig venter med at studere indretningen i tårnet til de er på vej ned igen. Generelt skal man vige for gæster på vej ned, bortset fra hvis man får en anden besked af guiderne.

Løse genstande som mobiltelefon, kamera, video o. lign skal transporteres i lommen eller i en lille taske med lynlås. Det anbefales at tage fingerringe af eller at tage arbejdshandsker på, når der klatres på stigerne.

Ved passage fra skib til vindmøllens fundament, skal begge hænder være frie, og instruks fra lauget og skibets besætning skal ubetinget følges.

Da der kan forekomme snavs og smørefedt i båden og møllerne, anbefales det, at man bærer praktisk tøj og sko med stive skridsikre såler. Derudover bør man medbringe en regnjakke, en flaske med vand og lidt frugt eller chokolade.

Jeg erklærer ved min underskrift, at jeg er indforstået med ovenstående betingelser og med at hele arrangementet foregår på eget ansvar, og at der ikke kan gøres noget erstatningsansvar gældende overfor Middelgrundens Vindmøllelag eller SPOK ApS i forhold til personlig skade foranlediget af uhensigtsmæssig adfærd, ødelæggelse eller tyveri af tøj eller personlige genstande.

Afgang den

Navn:

Underskrift:

Office: +45 3536 0219

CVR-#: 25 04 21 82

SPOK ApS

www.spok.dk

Frederiksborggade 1 – 4tv

Mobile: +45 2811 0219

E-mail: consult@spok.dk

DK-1360 Copenhagen K





Signature Statement visits Middelgrundens wind turbines, 2021 -

The trip out to the mills and the climb up in them is both a physical challenge and an experience out of the ordinary , but it is also a practical and security challenge . Therefore, it is essential that all guests read this statement carefully and agree to the these conditions and precautions. Persons under 18 may participate if accompanied by a parent who must stand as a signatory below.
This statement is part of the COOP's emergency plan.

When ascending the mill requires that:

- I am not under the influence of alcohol, medicine , or drugs,
- I do not suffer from claustrophobia or fear of heights ,
- I do not suffer from circulatory disturbances , dizziness , epilepsy, etc. and that ,
- I am in good physical shape and not have significantly reduced mobility .

I must pay attention to the markings that are set up in different parts of the mill and respect the instructions given by the guides and staff. At the ladder's in turbines applies that there may be only one person at each section, a maximum of three people on each floor (there are 11 floors) and a maximum of 18 people up in the nacelle – if not more accepted by the guide.

To ensure a steady flow of guests in the mill , It is important that the fastest guests climb up first , but waiting to study the interior of the tower until they are on their way back down. Generally, you must give way to the guests coming down, except if you get a different message from the guides .

Secure loose objects such as mobile phone, camera, video , etc. to be carried in a pocket or small bag with zipper . It is recommended to take rings or to take work gloves while climbing on ladders. Gloves are usually provided by the guide.

When passing from the vessel to the turbine foundation, both hands to be free, and the instructions of the guild and the ship's crew must be strictly followed. When needed safety vests are provided.

Because of risk of dirt and grease in the boat and wind turbines, it is recommended that you wear practical clothes and shoes with rigid non-slip soles. In addition, you should bring a rain jacket (if weather forecast gives risk of rain), a bottle of water and some fruit or chocolate.

In addition to these formal measures, we hope that all guests will positively contribute to the event by being patient in the event of delay and by showing respect for the other guests, so we all have a good experience with us home .

I certify by my signature that I agree with the above conditions and to the whole event takes place at your own risk and that there cannot be any liability claim against Middelgrundens Wind Coop or SPOK ApS in relation to the destruction or theft of clothing or personal items .

Date:

Name & signature:

Name & signature

Office: +45 3536 0219

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SPOK ApS

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DK-1360 Copenhagen K





APPENDIX 9 PASSENGER LIST USING ZODIAC

This list must be signed before entering a Zodiac

RibAlex.dk, -en del af CPH Shipping Gruppen.
+45 2840 6870 | booking@ribalex.dk | www.ribalex.dk

RIBALEX.DK
-en del af CPH Shipping ApS

PASSAGERLISTE

Venligst print og medbring den i udfyldt stand. Passagerliste udfyldes og afleveres til besætningen ved fremmøde.

Aftalt tidspunkt er afgangstid — der starter sejltiden. **Mødetid er mindst 15 min før afgang!**

Vær ikke urolig — vi kommer. Kan du ikke finde mødestedet, se vores hjemmeside under FAQ.

Undertegnede har modtaget og forstået sikkerhedsinstruktionerne.

Sikkerhedsinstruks gives umiddelbart før ombordstigning.

FØRSTE BÅD

NAVN (BLOKBOGSTAVER):	UNDERSKRIFT:

SEKUNDE BÅD

(kun hvis to ture/både)

NAVN (BLOKBOGSTAVER):	UNDERSKRIFT:

TREDJE BÅD

(kun hvis to ture/både)

NAVN (BLOKBOGSTAVER):	UNDERSKRIFT:

FJERDE BÅD

(kun hvis to ture/både)

NAVN (BLOKBOGSTAVER):	UNDERSKRIFT:

JURIDISK BINDENDE DOKUMENT

SIDE 1/1





APPENDIX 10 WHAT YOU SEE ON THE WAY OUT

Copenhagen landmarks we see on the way out:

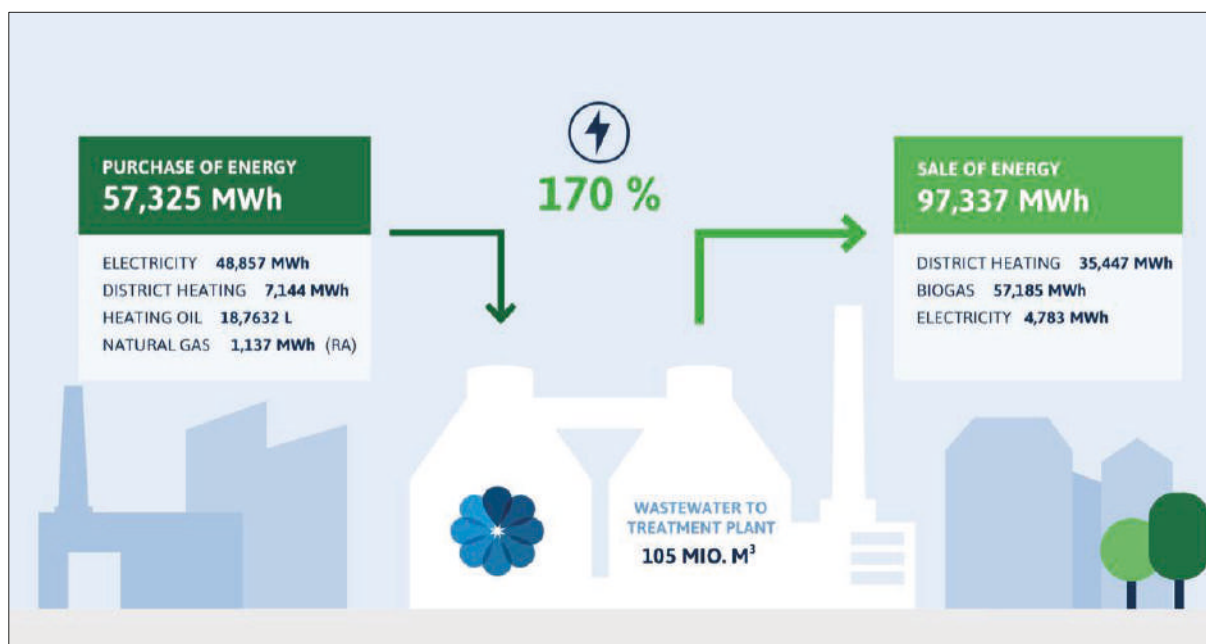
- Opera and Royal castle.
- The little mermaid.
- The New Nordhavn container terminal
- The United Nations (UN) city building
- Copenhagen Infrastructure Partners headquarters (*Nordø*) building
- Refshaleøen
- The *Trekroner Fortification* and The Defence islands *Middelgrunden* and *Flakfortet* from 1902

The Lynetten Wind Farm

Seven 600 kW Bonus turbines established 1996. 3 owned by HOFOR and 4 by a cooperative of 900 members. The cooperative sold the turbines in 2019 as they could not get lease for more than a year.

The Biofos Wastewater Plant

Treating wastewater for 1.2 million people.



Source: Biofos

The Barsebäck nuclear power plant in Sweden

Swedish Nuclear power plant: Barsebäck: 1200 MW. From 1975 (started operation in 1975). Closed down in 2005. Probably due to various reasons:

- Great opposition from DK to nuclear
- Undoubtable Transition to more REs in the energy mix
- Old (from 1975)

Now 25 years stopped to lower down the radioactivity.





The B&W drydock

Abandoned ship yard where the drydock was used to cast the concrete foundation for Middelgrunden Wind.

The Amagerværket power station

Amagerværket: Vattenfall's combined heat and power plant. Vattenfall's 583 MW Amagerværket (Amager) coal-and-biomass-fueled CHP plant. Coal, wood pellets & straw. HOFOR has taken over Amagerværket in 2014, and has moved from coal to biomass. It has 2 blocks and 2 chimneys. Wood pellets from Russia and Canada. Straw from Danish farms.

The CopenHill/Amager Bakke

Waste treatment plant (manufacturer: Babcock & Wilcox Vølund A/S) operated by HOFOR.

- Equipped with two furnace lines and a joint turbine-generator system. The plant replaces a 45-year-old plant with 4 furnace lines. The plant burns 2 x 35 tonnes of waste per hour.
- Treating around 400,000 tonnes of waste annually produced by 500,000 – 700,000 inhabitants and at least 46,000 companies.
- Supply a minimum of 50,000 households with electricity (Electricity for 62,500 households) and 120,000 households with district heating.
- Have steam data at 440 degrees and 70 bars which doubles the electrical efficiency compared to the former plant.
- In addition to the technological merits, the plant's architecture includes a roof-wide artificial ski slope open to the public. Known by the name of *CopenHill* it is inspired by the ski slopes in the Alps. Source: the architect BIG.
- The total price is about 3.5 billion Danish kroner (approx. USD 610 mill.).

The Prøvestenen Wind Farm

3 Vestas 2 MW turbines from 2013. One turbine owned by 500 shareholders.

The Øresundsbridge

The beautiful bridge built in year 2000 connecting Sweden and Denmark for the first time by road. It has a curved shaped and ends as a tunnel on the Danish side.

The Lillgrund offshore Wind farm I Swedish water

Located about 10 km off the coast of southern Sweden. With 48 wind turbines (Siemens SWT-2.3-93) and a capacity of 110 MW. The farm's turbines have a rotor diameter of 93m and a total height of 115 m.

About 16km from Middelgrunden to Lillgrund.





APPENDIX 11 ANECDOTES

The origin of Middelgrunden reef

The reef on which Middelgrunden wind farm is located is natural. It was formed 8,000 years ago, when a glacial age barrage (created 10,000 years ago), in the Stockholm/Uppsala area collapsed and created the three (deeper) channels that are sailing routes in the Copenhagen/Malmö area today.

During the excavation and exploration of the farm, remains of modern boats (wrecks) were found, of 21 and 27 feet, in the reef west of the turbines. If they had been old wrecks, they surely would have had a problem.

The grid connection – Middelgrunden as a missile base

The defence island outside Copenhagen Middelgrunden was the easternmost NATO station direct to fire missiles at St. Petersburg region and the air defence of Copenhagen. It had its own electricity production, but was also connected to the city by cable. When the failure probability analysis was studied to plan the Middelgrunden cable, in 1997, the history of failures of the neighbouring cable, the one on the island, was looked at – it was found that for each year from 1960 to 1984, every April and October, a ship (fishing boat type from Poland) broke the cable by dropping the anchor.

Due to navigation rules, it is not allowed to stop and park there unless a boat breaks down. This fishing boat entered the port of Copenhagen every time, and on the way, its engines "broke", it launched a SOS, and it almost always broke the cable when it dropped the anchor.

The 2nd World War bombs

Royal Airforce carried out a bombardment of the Gestapo head quarter March 1945 to destroy the files with the names of the Danish resistance movement.

During the construction period six unexploded bombs from World War II were found. These were bombs dropped into the sea on the way back to relieve the weight of the airplanes. During construction we had cameras on the grab mowing the soft material to the barge and they were detected that way. The bombs were not detected by the side scan sonar or the magnetic scanning of the seabed probably as they were covered by a lot of soft sediments. The Navy detonated all six the following day; all of them worked still after 55 years in the sea.

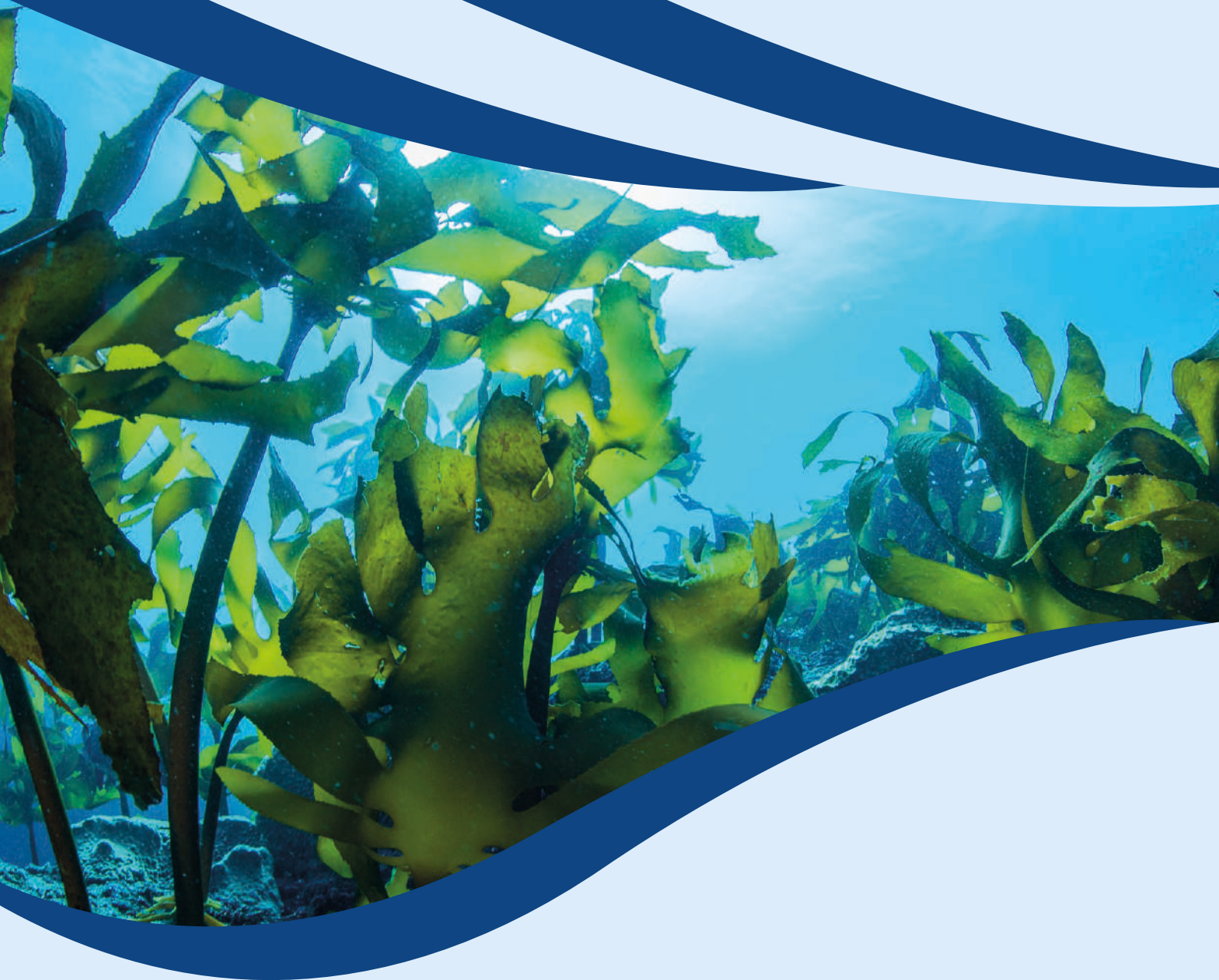
The navigation safety

In 2013 the farm was 8 minutes from being hit by a Russian ship. The main risk of collapse in Middelgrunden comes from ships sailing free of cargo. The Drogden lighthouse – outside the airport informs ships that they have to turn their path half a degree east to avoid colliding with the reef and Middelgrunden Wind Farm.

In 2013, when the Navy radar that monitors traffic around the Øresundsbridge detected that a ship did not turn. A helicopter, with a pilot on board, descended from the helicopter, and he turned the freighter around 8 minutes before it collapsed, finding the entire crew drunk.

Similar events happened caused by Russian ships (only Russian crew) 3 times more in Danish water since 2009. Two ships ended up on the beaches in the south forgetting to turn to the north and one ship hit the Great Belt bridge (1,800 m long) at the lower part of the bridge. All caused by drunken crews.





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