

Guidance on Executive Order on technical certification and servicing of wind turbines, etc.

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Background

Executive Order no. 1773 of 30 November 2020 on technical certification and servicing of wind turbines, etc. constitutes a fundamental revision of the now historical Executive Order no. 73 of 25 January 2013 on a technical certification scheme for wind turbines.

With this revision, the rules have been adapted to the contemporary market for wind turbines, and they have been targeted at requirements for safety and for servicing wind turbines. Safety in this context means the wind turbine's structural safety as well as safety and security pertaining to the turbine's surroundings.

Provisions concerning documentation of power quality and interaction with the grid are provided for under other regulations, e.g. EU regulations on grid connection.

Furthermore, previous provisions concerning documentation of wind turbine energy production are now dealt with by today's wind turbine market, where professional erectors have a financial interest in making profitable investments and demand compliance with regulations and with standards.

In line with the previous versions, this new Executive Order stipulates provisions on requirements for certificates for wind turbines and requirements for certification of undertakings.

Another central element of the Executive Order are requirements for owners to ensure that their wind turbines are serviced and maintained.

Target group

The wind turbine sector is a mature and professional sector that produces and erects wind turbines.

The target group of this guidance document primarily comprises owners and undertakings

which service wind turbines; municipalities; and other interested parties; as well as, to a lesser extent, players expected to have deep and thorough knowledge about legislation and standards in the area. The latter includes accreditation and certification bodies, manufacturers, importers, and undertakings issuing type or project certificates.

Objective of this guidance

The objective of this guidance document is to provide an introduction and overview of the regulations, as well as tips, e.g. for how owners or service undertakings can meet the rules pursuant to the Executive Order.

Among other things, this guidance document contains examples on how owners of wind turbines with a rotor area of less than 40 m² can design a service and maintenance log; how a safety and function test can be performed if the wind turbine has been out of service; as well as examples illustrating which types of certificate are required in which situation.

The guidance document is moreover to provide an overview of how the various areas regulated by the Executive Order are inter-related.

To understand the specific obligations and requirements that apply under the scheme, read the Executive Order itself.

The executive order is legally binding and has legal effect similar to a law while the guidance paper is not legally binding, to neither citizens nor government authorities.

The purpose of the guidance paper is to help explain the content and background of the rules and how the rules should be understood, while the executive order is the concrete rules that specify and supplement the rules of the law.

Note that other legislation is in force that also needs to be observed and complied with, e.g.

legislation regulating electricity conditions, grid connection, noise, planning for wind turbines, workplace safety and health, production and work on the wind turbine in connection with erection, relocation and dismantling.

These are the wind turbines covered

Electrical energy covered, but not mechanical energy and wind turbines on ships

In general, the Executive Order applies only to wind turbines which generate electrical power via a generator and not wind turbines that convert the wind into mechanical energy, e.g. to operate a water pump or grinding mill. For example, old Dutch wind turbines and windmills with adjustable narrow vanes.

Wind turbines on ships are exempt from this Executive Order because ships are instead regulated under international regulation concerning ships.

Wind turbines only producing for own consumption and wind turbines out of service are covered

Wind turbines that are connected to the grid but that are not supplying electricity to the grid still have to be safe, which is why they are covered by the Executive Order. This may be the case for small wind turbines with an electricity capacity below 25 kW and which can use all of the power produced for own consumption.

This may also be the case for both smaller and larger wind turbines that are periodically put out of service. See section "All wind turbines must be serviced and maintained" for the more detailed rules in connection with servicing and reporting.

Wind turbines not connected to the collective grid but running in automatic operation

The Executive Order also covers wind turbines in automatic operation that are not connected to the collective electricity supply grid, that supply electrical energy and that run in so-called island

mode operation, i.e. without link up to the collective grid.

Automatic operation is when the wind turbine has a control system that prevents it from running out of control. Such a system can be electrical, computer-based or mechanical.

Wind turbines deregistered from the collective grid

The Executive Order also, in some situations, covers wind turbines that have been deregistered from the collective grid but have yet to be dismantled.

Wind turbine types and calculation of rotor area

Nearly all wind turbine types are covered by the Executive Order, irrespective of their technical design.

The most common wind turbine type is the horizontal axis wind turbine (HAWT) with a traditional three-blade or two-blade design, while a vertical axis wind turbine (VAWT) has vertically oriented blades that rotate around a vertical axis and form a cylinder or an oval shape rotor.

There are no differences in the rules pertaining to these different wind turbine types.

However, in a number of areas, the Executive Order does distinguish between different rotor area sizes, and, in one instance, according to wind turbine capacity.

The following distinctions are made concerning the rotor area:

- 5 m² and less
- more than 5 m² and up to and including 40 m²
- more than 40 m² and up to and including 200 m²
- more than 200 m²

The rotor area can be calculated as $A = \pi r^2$. Where 'r' is half the rotor diameter.

For vertical axis wind turbines, the rotor area is calculated by multiplying the rotor height by the rotor diameter or the spectrum of the spread of the rotor blades. This will give you the swept area.

The Executive Order in one instance refers to a wind turbine of the stall-controlled type.

The blades on a stall-controlled wind turbine are bolted directly onto the hub. The pitch of these blades cannot be adjusted and the wind turbine has passive power control. This concept is primarily in older wind turbines with a capacity of up to 1.5 MW. Compared with pitch-controlled wind turbines, controlling and monitoring stall-controlled wind turbines is less complex.

Newer and larger wind turbines are typically pitch-controlled, which means their blades can be pitched both in connection with power control and as a safety measure when the wind turbine stalls during strong winds. The controls in pitch-controlled wind turbines are extremely specialised and complex, and therefore require service and maintenance technicians to have a deeper insight into these types of control.

Wind turbines are subject to certification

Almost all wind turbines are required to have a certificate before they can be legally put into service. The certificate is documentation that an independent third party has verified that the wind turbine has been designed and tested according to the rules in the Executive Order. The certificate is also documentation that a third party has made sure that the wind turbine type in question is being produced with a well-documented quality management system.

The Danish Energy Agency maintains a website on non-expired certificates for wind turbines.

Find the website (only available in Danish) under 'certificeringer' at cas.ens.dk.

Standards, procedures and rules

Wind turbines are generally designed, tested and certified in accordance with international standards, procedures and regulations.

IEC 61400 Series

The most common standards for the design and testing of wind turbines are the standards in the IEC 61400 Series. These standards are developed collaboratively between wind turbine manufacturers, wind turbine owners, certification companies and other stakeholders, as well as sub-suppliers within the sector, in accordance with the rules set out for such collaboration by the IEC organisation (see www.iec.ch).

In addition to the standards, the IEC organisation has also developed an overall system for certification of wind turbine components, wind turbines and wind farms, called IECRE.

OD-501 and OD-502

The system for type approval of wind turbines is called IECRE OD-501:2018 Type and Component Certification Scheme and for approval of wind turbine projects it is called IECRE OD-502: 2018 Project Certification Scheme. The rules in these systems are the basis for the requirements laid down in the Executive Order. Previously, wind turbines and wind turbine projects were typically certified in accordance with the IEC 61400-22 standard. A major part of the contents of this standard has been continued in OD-501 and OD-502, although some matters have been updated.

Small turbines

The IEC 61400-22 standard may still be used for small wind turbines, because it contains a specific reference to a standard for wind turbines not covered by the IECRE system.

Freedom of methodology

The Executive Order describes the requirements on safety and health in IECRE OD-501, IECRE OD-502 and IEC 61400-22 as minimum requirements. This means you have freedom of methodology to choose other standards and

procedures, provided, as a minimum, they contain the same elements and ensure that the same level of safety is achieved.

One wind turbine; several types of certificate

There are several types of certificate:

- Certificates for wind turbines not yet fully tested: prototype certificates.
- Certificates for fully tested wind turbines: type certificates.
- Certificates for wind turbines that have been modified or relocated: supplementary certificates.
- Certificates to ensure that the impact of the site of erection on the wind turbine has been examined: project certificates.

Over time, several certificates will be involved for a wind turbine type, which is first developed, then tested and eventually series-produced.

Pending items in certification

In situations with pending items in certification of a wind turbine, a temporary certificate may be issued pending the issue of a final certificate. Such a certificate was previously known as a B certificate; however, in the new Executive Order this certificate is called a provisional certificate. A provisional certificate is only issued if the pending items are not essential for safety. A provisional certificate is therefore a way of dealing with pending items in certification in a way that is both flexible and appropriate.

On the content of a certificate in general

A certificate - whether it be a type certificate, a project certificate or a prototype certificate - usually includes the following information:

- Certificate no. and version
- Name of issuer
- Name of certificate holder
- Date of issue
- Date of expiry
- Technical data on the wind turbine (type)

- References to documents, etc. on which the issue of the certificate is based
- References to the standards and the Executive Order according to which the certificate is issued
- Pending items
- Signature

If the certificate covers specific wind turbines - as opposed to a specific *type* of wind turbine - the physical location and the unique GSRN of the wind turbine must also appear from the certificate. For example, this is the case for a project certificate or a prototype certificate. GSRN is an 18-digit unique identification number identifying the wind turbine in question.

A type certificate is valid for the wind turbine type specified in the certificate. The specification on the certificate may, however, include alternative variants with different components and configurations, as well as tower types, for example. If several different types of wind turbine tower are used, for example, then there must be verification for tower strength for each tower type.

Front page of the certificate

Some international certificate templates (e.g. IECRE) do not take account of Danish rules or of the use of GSRN in Denmark. In such cases, the issuer of the certificate can add a front page to the certificate with a reference to the Danish Executive Order and the GSRN.

Expiry date for certificates

A type certificate will have an expiry date. This date indicates how long the specific type of wind turbine may be produced, sold in the market and erected. For a wind turbine erected with a valid type certificate and project certificate, the certificates will in practice be valid throughout the wind turbine's lifetime and will therefore not run out of date.

However, for time-fixed certificates, e.g. provisional certificates, the expiry date on the certificate indicates that the wind turbine must be dismantled

after expiry, unless a final certificate is issued, or the provisional certificate is extended.

For a provisional type certificate, possibilities for extension are limited. Therefore, no more than three years must have passed from the issue of the first provisional certificate until the expiry of the most recent, extended provisional certificate.

By no later than at the first extension, a source noise measurement must be available that has been prepared in accordance with the Ministry of Environment and Food of Denmark's Executive Order on noise from wind turbines.

Danish requirements for noise measurement, etc.

There are specific requirements for measurements of noise from wind turbines in Denmark. These are stipulated in the Executive Order on noise from wind turbines, which includes rules on measuring low-frequency noise.

Development of a new type of wind turbine

Prototype

When producers or manufacturers begin developing new wind turbine types, the first phase will typically be to develop a prototype. Before the manufacturer puts such a prototype into service, the turbine needs a prototype certificate.

This also applies if wind turbine types are developed following modification of an already type-certified wind turbine. In such situations, a plan for tests and demonstration of the wind turbine must be prepared. Read more about this in section "Changes to or relocation of existing wind turbines" on changes to wind turbines.

For prototype certification of wind turbines with a rotor area of more than 5 m² and up to and including 200 m², the requirements to be met are, as a minimum, those set out in IEC 61400-22 on health and safety.

Wind turbines with a rotor area of more than 200 m² must, as a minimum, meet requirements corresponding to those set out in IECRE OD-501 on health and safety.

Expiry of prototype certificates

When a prototype certificate has expired, the wind turbine must be dismantled, the certificate must be extended, or the certificate must be replaced by a new certificate.

Fully tested wind turbine type

A fully tested new wind turbine type can obtain a type certificate when and if the relevant requirements have been met.

A distinction is made between large and small wind turbines.

Wind turbines with a rotor area of more than 5 m² and up to and including 200 m² must, as a minimum meet requirements corresponding to requirements set out in IEC 61400-22.

Wind turbines with a rotor area of more than 200 m² must, as a minimum meet safety and health requirements pursuant to the IECRE OD-501 standard.

Expiry of type certificates

A type certificate is issued to the manufacturer, importer or producer and is typically valid for no more than five years. This means that the wind turbine can be sold in the market and may be erected within this five-year period.

Wind turbines with a valid type certificate at the date of erection therefore do not have to be dismantled when the type certificate eventually expires.

Wind turbines exempt from certification or subject to relaxed terms of certification

Wind turbines with a rotor area of up to 5 m²

All wind turbines with a rotor area of up to 5 m² are exempt from the requirement for type certification but must comply with all other relevant requirements in the Executive Order. Among other things, this means the wind turbine must be serviced and maintained in accordance with the manual, see more under section "All wind turbines must be serviced and maintained".

All wind turbines with a rotor area above 5 m² must therefore be certified. However, see below for information on two exceptional situations that trigger exemption.

Home-built wind turbines - relaxed requirements

In situations where home-builders design and produce their own wind turbine, the wind turbine is not exempt from the requirement for certification, but the process of certification is less strict. This applies to wind turbines with a rotor area above 5 m² and up to 40 m².

On the other hand, the wind turbine may not be sold or erected at a new site. A new owner of the property containing the site of erection of the wind turbine may, however, take over ownership of the wind turbine.

The requirements for the less strict certification process are described in more detail in Annex 2 of the Executive Order.

Wind turbines for teaching activities and similar

The Danish Energy Agency may exempt wind turbines from the requirement for certification in exceptional circumstances, for example if it can be documented that the wind turbine is being used for teaching, research or testing. This applies to wind

turbines with a rotor area above 5 m² and up to 40 m². Read more about the terms and conditions in section 10(2) of the Executive Order.

Exemption from the requirement for certification does not, however, release the wind turbine owner from the obligation to comply with all other relevant requirements in the Executive Order. Among other things, this means the wind turbine must be serviced and maintained in accordance with the manual, see more under section "All wind turbines must be serviced and maintained".

Project certification: Documentation of the impact of the site of erection on the wind turbine

In addition to type certification, large wind turbines with a rotor area above 200 m² also have to be project certified.

A project certification entails an evaluation of whether there are adequate assessments of the following:

- The wind turbine is suited for the specific location and the relevant wind class
- The foundation has been designed using the correct loads
- The local conditions, e.g. soil conditions, have been correctly assessed
- Transport to and from the site of erection was in accordance with the manufacturer's instructions
- Commissioning and testing of the wind turbine were in accordance with the manufacturer's instructions

Wind turbines with a rotor area above 200 m² must therefore be project-certified, as a minimum in accordance with the requirements set out in IECRE OD-502 on health and safety.

Only wind turbines with a rotor area above 200 m² need to be project-certified, and only if the wind

turbine in question is new and type-certified or if it is a modified wind turbine.

Prototypes or relocated wind turbines will, at all events, be assessed relative to the site of erection prior to issue of a certificate, and these wind turbines therefore do not have to be project certified.

A project certificate is linked to a specific wind turbine and GSRN. The purpose of the project certificate is therefore to ensure that the specific erection conditions for the wind turbine have been taken into account.

A project certificate can cover a wind farm with several wind turbines and can be issued to one or several owners. However, no more than one project certificate will be issued for the same wind turbine or wind farm, even if there are several owners.

Expiry of project certificates

In practice, a project certificate will be valid for as long as the wind turbine is erected.

Changes to or relocation of existing wind turbines

If a wind turbine is relocated from one site to another, the wind turbine will have to be certified anew according to the new locality with a so-called "supplementary certificate".

The same applies to all types of modifications to wind turbines if no international certification standards are available.

There are currently no international standards for this type of certification process; referred to as "supplementary certification" in the Executive Order.

The Danish rules therefore fill a gap by defining requirements for the certification process, for the content of the certification report, and for the

information to be included in the certificate. The requirements for relocations and modifications are compiled in Annex 3 of the Executive Order.

Note that, in addition to the Executive Order, other legislation also applies for electrical engineering and grid connection in situations when wind turbines are modified or relocated.

A certification process in connection with a relocation or modification will typically begin with the owner submitting an application to the certifying undertaking.

Assessments of modifications

When an existing wind turbine is modified, the owner must always assess whether the change, or several individual changes, necessitates a supplementary certificate to the certificate with which the wind turbine was originally erected.

If there are several less substantial individual changes, these need to be assessed as to whether they together necessitate a supplementary certificate.

The undertaking performing the certification can assess whether there is a need for a supplementary certificate, and the owner can therefore always contact the undertaking for an assessment if they themselves are in doubt. See below for examples of situations in which a supplementary certificate is needed.

On the other hand, the owner is not required to ask an undertaking that can issue certificates to assess whether there is a need for supplementary certification in connection with every modification.

However, since the owner is ultimately responsible for the wind turbine, the owner always has to be able to document that a modification is covered by the existing certificate if the wind turbine is the subject of an inspection.

Below are examples of changes that may require a supplementary certificate:

- a) An older, small wind turbine is so damaged that repairing it would be too costly. The tower and the foundation are fine, but the nacelle and the wind turbine control system are replaced with another, used nacelle and associated control system. If the used nacelle is of another brand or type, a supplementary certificate will be required.

If the rotor diameter is the same and the same brand and type of blades are used, and if the rotor speed is comparable, typically all that is needed is an assessment/verification of the assembly between the existing tower and the new nacelle. Typically, in this situation, a tower element of 0.5 - 1.0 meter in length will have to be added, with a flange at either end, or a thick flange with two rows of holes.

- b) A wind turbine control system has been considerably damaged or breaks down so often that it is replaced with an entirely new control system. Here, the supplier of the new control system will have to "read" the controls' functions during operation by monitoring ingoing and outgoing data from the existing controls.

Based on this data, new controls will be programmed to resemble the existing controls as much as possible. However, improvements will usually be implemented as well. The controls' functions and safety are verified by testing and plotting time series showing ingoing and outgoing data and the turbine's reaction.

- c) All welding operations on tower or nacelle components that are part of the load path from rotor to foundation.

Note that in each case, an assessment on an individual level will be made.

Below are examples of changes that will probably not require a supplementary certificate:

- a) Replacement of main components with another brand included in the original type certificate or added in connection with later certifications.
- b) A blade falls off the wind turbine and causes a large dent in the tower. The main axis and main bearings are also damaged. Another, used wind turbine of the same brand and type, including tower, is mounted. The changes therefore exclusively involve replacements with identical parts. Although the entire turbine is replaced, except for the foundation and perhaps also the wind turbine controls, these changes constitute repairs, and a supplementary certificate is therefore not required.
- c) Replacements of smaller components with no significance for safety.
- d) Installation of extra cooling/cooling system for gears or generator.

Note that in each case, an assessment on an individual level will be made.

Updating project certificates

If it has been necessary to have the wind turbine supplementarily certified, the owner must ensure that any project certificate for the wind turbine is also updated. Therefore, the changes to the wind turbine must be assessed as to the impact of the site of erection on the modified wind turbine.

This will only be relevant if the wind turbine already has a project certificate. It will therefore not be relevant for wind turbines that have been prototype-certified or turbines with a rotor area of or below 200 m².

There are no requirements to update the project certificate of wind turbines that are relocated to a new locality without otherwise being changed. However, the impact of the site of erection on the wind turbine must be included in the supplementary certification required due to the relocation.

Expiry of supplementary certificates for wind turbine relocations and modifications

There is no expiry date for supplementary certificates for relocation of wind turbines or for supplementary certificates for modifications, except where this is for test and demonstration purposes. For a modification for test and demonstration, the supplementary certificate is valid for three years and may be extended by up to one year.

Several identical modifications to wind turbines of the same type

The supplementary certificate is usually issued to the owner of the specific wind turbine to be modified.

In exceptional circumstances, however, a manufacturer, importer or supplier may offer to perform identical modifications to several wind turbines of a specific wind turbine type, such as installing a new control system.

In these situations, the process will usually be:

- 1) The manufacturer, importer or supplier applies to a certifying undertaking for supplementary certification of a modification of a specific wind turbine based on outlines, drawings and calculations.
- 2) After the modification, an assessment will be made to determine whether a supplementary (or provisional) certificate can be issued for the first modified wind turbine. This certificate will refer to the wind turbine's unique GSRN.
- 3) Then, a more general supplementary certificate will be issued, also referred to as a "general modification certificate", although this may have minor changes compared with the first modification.
- 4) This supplementary certificate ("general modification certificate") must accurately define the wind turbine population covered, e.g. referring to: type, version, year, serial number or GSRNs.

- 5) The supplementary certificate is issued to the manufacturer, importer or supplier.
- 6) The owner receives a copy of the supplementary certificate after implementation of the modification.

The supplementary certificate issued for several identical modifications to wind turbines of the same turbine type can therefore be considered as an add-on to the first supplementary certificate issued for the first modified wind turbine of the wind turbine type in question.

Because no pending items are allowed at this stage of the certification process, it is not possible to have a provisional supplementary certificate issued.

Expiry of supplementary certificates for identical modifications to the same turbine type

Supplementary certificates for identical modifications to the same wind turbine type are issued with a validity of five years, corresponding to the validity of an ordinary type certificate, which, however, can be extended.

Several types of changes at the same time

In some situations, a wind turbine may be both modified and relocated at the same time. A combined "modification and relocation certificate" can then be issued, provided the certificate covers all the conditions relevant for the two situations, i.e. modification and relocation.

Annex 3 to the Executive Order provides a full description of the possibilities to obtain a supplementary certificate. Here, you will also see that many of the matters to be covered by the certification process and by the certificate are the same for the two situations.

All wind turbines must be serviced and maintained

The service obligation

All wind turbines must, without exception, be serviced and maintained for as long as they remain erected.

The wind turbines are to be serviced and maintained in accordance with the service manual or the type certificate.

The service obligation entails that:

- The wind turbine must be serviced and maintained on a regular basis
- Repairs must be made as needed
- The wind turbine must be inspected on a regular basis
- In the event of major damage or accidents, the owner must report the incident to the Danish Energy Agency, see section "Roles and responsibilities".

However, the Executive Order makes a distinction between wind turbines with a rotor area above or below 40 m². Furthermore, the Executive Order describes who can carry out service and how to document this.

The service manual

The service manual is the basis for servicing and maintenance of wind turbines. The supplier, importer or manufacturer must provide a service manual and a user manual to the wind turbine owner upon delivery of the wind turbine.

The service manual contains a more detailed description of how to maintain and service the wind turbine. Typically, the manual will also specify how often the various checks have to be performed and will, thus, indicate the service interval.

The EU Machinery Directive contains a description of what a user manual should contain.

Owners of wind turbines are entitled to have any later updates to the service manual forwarded to them free of charge, where such updates are of significance for the safety of the wind turbine.

The service undertaking performing service on the wind turbine is responsible for updating the service documentation for the wind turbine. Read more about the obligations of service undertakings in subsection "Service undertakings" in section "Roles and responsibilities".

Service frequency

As a rule of thumb, service must be performed at the interval specified in the manual. For example, this may be every six months, every year or every other year.

However, in some situations, a service interval will not be specified in the service manual or in the type certificate.

There are two such situations:

Wind turbines with no service interval indicated in the service manual or in the certificate

Service should be performed at intervals of no more than one year.

Very modern and future wind turbines with technical solutions for indicating the need for service

For some very modern wind turbines and for future wind turbines with certain technical solutions, no fixed time interval for service will be indicated in the manual. Instead, the technical solution will clearly indicate when a service visit is required.

This applies to wind turbines that have been designed with a type of technical solution that reduces the need for physical inspections and that instead collects data for subsequent review to determine whether a physical inspection is required. The review of data should be performed at least once every year and should be reported. The Executive Order does not stipulate

requirements for the frequency of physical service visits, but other legislation may do so.

Extended service requirements for older wind turbines

The service requirements increase with the age of the wind turbine. When the wind turbine has exceeded its designed useful life, which is often 20 years, there will be requirements for extended service. The requirements for extended service are described in Annex 4 to the Executive Order.

The designed useful life will typically appear from the type certificate. If the certificate does not indicate the designed useful life, it will be fair to assume a useful life of 20 years.

Service to be performed by experts for wind turbines above 40 m²

Wind turbines with a rotor area above 40m² must be serviced and maintained by a licensed or certified service undertaking.

This also means that owners of wind turbines with a rotor area of 40 m² or less do not have to have their service and maintenance performed by licensed or certified service undertakings. However, there is still a general requirement for service and maintenance to be performed. Read more in section "All wind turbines must be serviced and maintained".

The Danish Energy Agency keeps a website at www.cas.ens.dk, which lists all undertakings with a valid licence or a valid certificate. The website also has information about the types of wind turbine the individual service undertaking is licensed or certified to service. Furthermore, there are undertakings licensed exclusively to perform certain, specific service tasks, such as blade inspections.

Service undertakings that have been licensed by the Danish Energy Agency or have been certified by an undertaking that carries out certification have been subject to an assessment of whether their

competences and qualifications, as well as their experience on wind turbines, are adequate. Such assessment includes whether the procedures an undertaking has in place to ensure compliance with the requirements in the Executive Order are adequate. Finally, the undertaking must be in possession of the relevant manuals and tools to perform the task.

There are a few exceptions from the rule that service must be performed by a certified or licensed service undertaking. These comprise situations in which owners have been licensed under the former regulatory basis to perform service on their own wind turbine if they could document having the qualifications for such servicing and could document that exceptional circumstances required them to perform service themselves.

When establishing a service contract with a service undertaking, an owner must make sure that the wind turbine type in question is listed in the service undertaking's list of wind turbines, which is available on the website. If it is not, the undertaking is not permitted to service the wind turbine. However, the service undertaking can choose to become certified or licensed to perform service on the wind turbine type in question. Usually, this will entail that the undertaking contacts the undertaking that initially certified it and request to have the relevant wind turbine type added to its list of wind turbines.

Owners have no guarantee there will be a licensed or certified service undertaking to service their specific wind turbine type. Instead, owners will have to contact existing licensed or certified undertakings to hear about the possibilities for servicing. Sometimes the reason for the lack of service possibilities is that there are only a few, perhaps only one wind turbine, left in Denmark of the turbine type in question. Another reason may be the unavailability of spare parts for the wind turbine type in question.

As a consequence, the owner of the wind turbine may ultimately have to dismantle the wind turbine.

Service report

After each service visit, the service undertaking prepares a service report and a service check list, which the owner then receives. Service report outlines the tasks carried out in accordance with the service manual, as well as the date and the name of the person who carried them out.

The service report is the owner's proof that a task has been performed in accordance with what has been agreed between the service undertaking and the owner.

To the extent possible, the service report should also be available in an electronic version.

Service of wind turbines above 40 m² reported to the Danish Energy Agency

To be able to check whether the wind turbines are being subjected to regular service visits, regular service visits on wind turbines with a rotor area above 40 m² must be reported to the Danish Energy Agency.

However, the obligation to report servicing, applies only to planned, regular service visits in accordance with the service manual, and therefore not when repairs, etc. are being performed.

The reporting is to be done by the service undertaking which performed the service visit or by the owner who is licensed to service their own turbine.

The Danish Energy Agency runs a digital self-service portal, and this portal must be used for the reporting. To access and use the portal, you will need a specific licence. A form is available on the Danish Energy Agency website:

ens.dk/service/indberetninger/selvbetjeningsportal for use when applying for access to the portal.

Reporting for modern wind turbines with technical solutions with service indicators

For the very modern wind turbines and for future wind turbines with certain technical solutions for which the service manual does not indicate a fixed

time interval for service, it is not possible to report the date for the next service visit based on the wind turbine's service manual.

The service portal will also ask for a date for the next service visit. In these situations, the service undertaking can therefore choose to enter a date for the next service visit one year after the date of the review of the service indications from the technical solution. This means, the wind turbine's technical indications will always be checked at least once a year. This means that the service undertaking must evaluate the need for performing the actual service, but service not necessarily has to be performed if there is not data that indicate a need of this.

Service of wind turbines below 40m² to be kept in a log

There is no requirement for servicing to reported to the Danish Energy Agency for wind turbines with a rotor area of or below 40 m².

As something new, however, a requirement has been introduced for owners of wind turbines with a rotor area of 40 m² or less to keep a log of servicing carried out on the wind turbine. This log must be kept at the wind turbine.

Log

As a general rule, a log should be available at all wind turbines. This can be a logbook updated in writing manually, or a folder for archiving loose sheets of paper. The log is to be placed at the wind turbine.

Some service undertakings use loose sheets of paper which can be printed before the visit to the wind turbine. These loose sheets of paper are then archived in a folder. If the system with a folder and loose sheets of paper is used, then the loose sheets of paper must be entered in the folder according to chronological order by those visiting the turbine. Possibly in combination with a separate logbook for notes by people other than people from the service undertaking.

The log can also be available in an electronic version instead.

Notes must be taken in the log every time the turbine is inspected, serviced, repaired or simply visited. As a minimum, the following must be noted:

- a. The date
- b. What was carried out
- c. Who carried it out

Example of log notes:

Date	Activity	Name/company
05.07.2020	Half-yearly service performed. Brake pads replaced and oil refill of gear unit.	N.Nielsen NN Servicevirksomhed
15.07.2020	Inspection of turbine. Nothing to report.	A. Jensen Turbine owner

When the wind turbine is out of service or is put into service again

Whenever a wind turbine is taken out of service (whether for repair, due to accidents, or for dismantling after end of service) or is put into service again, stopping or restarting of the wind turbine must be performed by people who are licensed or certified to perform these tasks. This applies to wind turbines with a rotor area above 40 m².

Wind turbines with a rotor area of 40 m² or less are not required to use a certified or licensed undertaking.

An undertaking that for example is specialized within particular components can be certified to exclusively perform the task of stopping, securing and starting the wind turbine again. The executive order and Annex 8 of the executive order contain

the requirements pertaining to undertakings that want to be certified to perform the task of stopping, securing and starting the wind turbine again.

While the wind turbine is not in operation, it must be serviced at least once a year, unless a shorter interval for service is indicated in the service manual.

Examples of securing wind turbines that are taken out of service

When wind turbines are taken out of service, they must be secured, see below for examples:

Wind turbines with fixed blades:

- 1) Tip brakes must be deployed.
- 2) Disc brakes must be kept under pressure (hydraulic or spring/mechanical), or, alternatively, the rotor must be blocked.
- 3) If the idle period is longer than the interval between service inspections, then service inspections must be performed at least once a year. Annual service inspections must, as a minimum, include:
 - a. Focus on structural safety as indicated for inspections after design life.
 - b. Checking that brakes / blocking of the rotor still work.
- 4) To prevent main bearings and bearings in gearing and generators from being damaged during idle mode, the brakes can be opened, and the rotating system can be rotated for some time. This can be done at appropriate intervals during the time the wind turbine is idle.

Wind turbines with adjustable blades:

- 1) The blades are locked in their 90-degrees position and the turbine is put in idle mode.
- 2) Alternatively: The blades are locked in operating position, and the rotor is blocked with a lock.
- 3) If the idle period is longer than the interval between service inspections, then service inspections must be performed at least once a year. Annual service inspections must, as a minimum, include:

- a) Focus on structural safety as indicated for inspections after the designed useful life.
- b) Checking that blades and idle mode still work.
- c) If the turbine is idling, checking whether rotating parts need greasing.

Note that in each case, an assessment on an individual level will be made.

Examples of safety and function testing in connection with putting into service

Function and safety testing must be carried out when the wind turbine is put into service again.

Testing the wind turbine's functions and safety devices can vary significantly, depending on the wind turbine design, size and age. A modern wind turbine has many different functions, while older and smaller turbines have fewer functions.

Function and safety testing means testing the functions that are relevant for the wind turbine's safety.

Functions such as starting and stopping power factor correction, registration and readout of temperatures, starting and stopping oil pumps, etc. have no relevance for the wind turbine's safety. However, for a wind turbine that has been idle for a very long time, e.g. more than a year, these functions should be tested before restarting the wind turbine.

Function and safety testing usually covers the following, as a minimum:

- 1) Testing the wind turbine's mechanical brake. Can the brake keep the wind turbine idle, and can the brake be deactivated and activated?
- 2) Testing the wind turbine's hydraulic system. This can be the mechanical brake, yawing, yaw brake, blade tips or adjusting

the blades. All functions operated by the hydraulic system should be tested.

- a. It must be possible to activate and deactivate the mechanical brake.
- b. Wind turbines with a hydraulic yaw motor must be able to yaw both ways.
- c. It must be possible to activate and deactivate the yaw brake. If reduced pressure is required during yawing, this must be checked.
- d. Wind turbines with blade tips/leading edge spoilers. Testing that blade tips/leading edge spoilers can be deployed and repositioned/retracted.
- e. Wind turbines with adjustable blades. The blades should be adjusted from one extreme position to the other extreme position. The controls for wind turbines may have different built-in functions for testing.

- 3) Testing emergency stopping. This may be tested from several places in the wind turbine. Testing must be performed at every such place. Testing must be performed when the wind turbine is on the grid.
- 4) Testing stopping the wind turbine in connection with vibrations.
- 5) Testing starting the wind turbine and connecting it to the grid.
- 6) Testing normal stop by pushing stop button. Checking that disconnection and braking work as designed.
- 7) Testing stopping in connection with overspeed. This can involve several levels with activation of several different sensors. All possibilities should be tested. However,

in some cases, deployment of blade tips/leading edge spoilers need not be tested:

- a. Where the wind turbine has an older design and where the deployment mechanism risk being damaged if deployed.
- b. Where anti-break fittings are used in the hydraulic system.

When performing repairs or improvements

Other tasks not related to regular service activities, such as improvements and repairs, can be performed by specialists not specifically licensed or certified.

Such specialists can either be certified themselves to stop, secure, start and test functionality and safety of the wind turbine type in question, or they can be certified or licensed for this together with a service undertaking.

If the wind turbine has an accident or experiences major damage

If there is an accident on a wind turbine or major damage to a wind turbine, this must be reported to the Danish Energy Agency without undue delay. The exact situations covered by this are given in Annex 6 to the Executive Order.

Roles and responsibilities

Owner

In brief, the owner is responsible for ensuring that any wind turbine they buy has a valid certificate and comes with a declaration of conformity and CE marking. On the Danish Energy Agency website www.cas.ens.dk is a list of valid certificates.

If the wind turbine has a rotor area above 200 m² then the owner must contact an undertaking that issues project certificates. Undertakings that issue project certificates are also listed on the Danish Energy Agency website www.cas.ens.dk. The

project certificate must be issued in connection with erection of the wind turbine.

The owner is obligated to ensure that the wind turbine is being regularly maintained and serviced, so that it does not pose any danger to its surroundings, and the owner must ensure that requirements under the Executive Order for reporting service are being met.

Furthermore, if the wind turbine has a rotor area above 40 m², the owner must employ a service undertaking to carry out servicing. The owner is also obligated to ensure that a wind turbine that stays in operation beyond its designed useful life is subject to extended servicing.

If the wind turbine is changed or adjusted, it is important for owners to ensure the change does not require a supplementary certificate. If the wind turbine is idle for a period, e.g. due to a damage, the owner must make sure that it is correctly secured and serviced. When restarting the wind turbine, the owner must ensure that function and safety testing is performed.

If there are operational changes or if the wind turbine is relocated, the Danish Energy Agency must be notified. This also applies in the event of accidents or severe damage to the wind turbine. In the case of an accident, the form in Annex 6 to the Executive Order should be used for the notification.

Service undertakings

To be able to service wind turbines with a rotor area above 40 m², the undertaking must go through a certification process with an undertaking that can certify service undertakings or through a licensing process with the Danish Energy Agency. The Danish Energy Agency can license service undertakings that service wind turbines that are stall-controlled and less than 600 kW. Read more in Annexes 7 and 8 to the Executive Order on the licensing and certification process, respectively.

The Danish Energy Agency updates and maintains a website: cas.ens.dk where you can find a list of licensed or certified service undertakings.

The undertaking may only service the wind turbine types which they have been licensed or certified to service. The undertaking's certificate or licence must be valid when it services the wind turbine. The undertaking has a three-month deadline for reporting in the service portal.

Regular service visits have to be carried out at intervals corresponding to what is outlined in the service manual, and the service undertaking must observe the requirements in the Executive Order concerning the service task and reporting.

If the wind turbine is older than the designed useful life, extended service visits are required.

At each visit, the service performed should be documented by submitting a service report and a service check list to the owner.

Service undertakings are also obligated to have the correct equipment, manuals and competences in the undertaking. The undertaking must have procedures in place to ensure compliance with the requirements for the service task and for service reporting for as long as the certificate or licence of the undertaking is valid.

The service undertaking must inform about all relevant changes with regard to the issued certificate or licence. This applies with regard to the Danish Energy Agency and with regard to the undertaking that certified the service undertaking.

The service documentation should be updated by the service undertaking if there are substantial additions to the manual based on the knowledge the service undertaking has of the specific wind turbine, and/or wind turbine type.

It is the obligation of the owner to report accidents or major damage, see subsection "Owner" in

section "Roles and responsibilities". However, the service undertaking can help the owner with this.

Undertakings certifying service undertakings

Undertakings that certify other undertakings to perform service and maintenance must be accredited to do so.

In their certification of the service undertaking, the undertaking must follow the requirements outlined in Annex 8 of the Executive Order.

Similarly, the undertaking must audit the service undertaking and thus ensure that work is being performed according to the service manual, etc. and pursuant to the rules set out in the Executive Order.

The undertaking that performed the audit will send an updated list of the wind turbine types that the service undertaking can perform service on to the Danish Energy Agency. The Danish Energy Agency will update the website: www.cas.ens.dk with the wind turbine types, so that wind turbine owners can keep up-to-date on service undertakings available to service their wind turbine. The requirements for audits by a service undertaking is in Annex 8.

That the undertaking certifying service undertakings is accredited means that an accreditation body (e.g. the Danish Accreditation Fund) has carried out an assessment of the undertaking. The accreditation body also audits the undertaking that certifies the service undertaking.

Undertakings issuing certificates on wind turbines or projects

Undertakings issuing type or project certificates must be either accredited or licensed by the Danish Energy Agency to do so. The individual certification undertaking can be accredited or licensed to issue different forms of certificates.

The Danish Energy Agency's website cas.ens.dk lists which undertakings can issue what forms of certificate.

Undertakings that have not been accredited by an accreditation body can be licensed by the Danish Energy Agency to issue type certificates or project certificates. However, this applies only to smaller wind turbines and only onshore projects. The undertaking must meet the requirements in Annex 9 to the Executive Order to obtain a licence.

Undertakings that have been accredited by an accreditation body to issue certificates on wind turbines or wind turbine projects will be subject to regular auditing by the accreditation body.