DANISH ENERGY AGENCY

MEMO

2 March 2015
Centre for Energy Resources

Grid connection of nearshore wind turbines established by tendering procedure

The Grid Connection Executive Order has been amended by Executive Order no. [1]220 of 2nd of March 2015 such that, among other things, a new section 6 has been inserted. Section 6 of the Executive Order relates to offshore wind turbines established in accordance with the "open-door procedure", but as it was decided in the 2012 Energy Agreement that nearshore wind turbines established in accordance with public tendering procedures are to be grid connected in the same way as in the open-door procedure, the amendment is also relevant for these turbines.

Below is a review of the content of the new section, including the responsibilities and costs which in future the concession owner, the grid company or the transmission company, respectively, are to bear in connection with grid connection.

Responsibility and costs allocation for grid connection

The provision contains an overall principle on clear segregation of ownership such that responsibility and costs for establishment, operation and maintenance belong together. Responsibility and costs separate at the grid connection point, i.e. at the transition from the concession owner's internal collection grid and grid routing onshore to the collective electricity supply grid (hereafter called the "connection point"). The connection point is a physical point in the grid and can be located in a station, a cable collection well, or similar.

The owner of the concession and the grid company or the transmission company may not impose unnecessary additional costs on each other, but they must work together to find the most economically optimal solution. The overall grid connection should therefore be established appropriately, in a socio-economic context, so that in setting cable routing, cable dimensions and voltages, account is taken for the total costs, subsequent grid losses and maintenance. The following describes how costs and responsibilities are allocated at grid connection.

Responsibility and costs borne by the owner of the concession

The owner of the concession is to supply the total output at one electrical point onshore and at a voltage agreed with the grid company or transmission company. This means that if the output is routed onshore through several cables, these are to be gathered, for example in a collection rail, before the output is supplied to the grid company. For the nearshore tendering pro-

[1]Executive Order no. 1063 of 7 September 2010 on grid connection of wind turbines and price supplement for electricity produced on wind turbines etc. and the amendment of 220 of 2nd of March 2015 of the Executive Order on grid connection of wind turbines and price supplement for electricity produced on wind turbines etc.

cedures, possible onshore routing corridors and connection points will be defined in the EIA reports.

The concession owner must operate and maintain the internal collection grid up to the connection point, and bear all the costs, risks and losses associated with this grid.

The owner of the concession must also cover the costs of acquisition and site development of the area required for expansion of the collective grid at the connection point. The area required is determined by the grid company or transmission company on the basis of the output and voltage at the connection point. The owner of the concession is also liable for any additional costs caused by specific landscape and environmental requirements at the connection point, for example camouflage requirements.

Responsibility and costs borne by the grid company or transmission company
The grid company or transmission company must connect the concession owner's grid to the collective electricity supply grid. The local licenced grid company is responsible for connection at voltages less than 100 kV, i.e. to the distribution grid, and the transmission company (Energinet.dk) is responsible for connection at voltages of more than 100 kV, i.e. to the transmission grid.

From the connection point, the collective electricity supply grid is established, owned and operated by the relevant grid company or transmission company. The grid company or transmission company is responsible for finding the optimal grid-technical solution in a socio-economic context, including transformation, and the costs necessary for this are covered by Energinet.dk through the so-called offset scheme.

The grid company or transmission company decides, establishes, operates and maintains the technical installations required at the connection point. The grid company or transmission company must also cover the costs necessary for expansion of the collective grid at the connection point, including a new transformer.

If the owner of the concession has special requests to reduce further the risk of break-downs, in addition to the solution determined on the basis of socio-economic calculations, for example locating an extra transformer at the connection point, by agreement with the grid company or transmission company this may be realised at the expense of the concession owner.

The grid company or transmission company must still pay the costs of expansion or reinforcement of the underlying electricity supply grid, see section 7(1) of the Grid Connection Executive Order (see illustration below).

Practical management of the grid connection
The output and voltage supplied at the connection point are crucial for the most efficient expansion of the collective grid. The voltage is agreed with the grid company or transmission company, which, among other things, is to offer 33 kV at the grid connection point. The grid company is responsible for any step-up at the grid connection point, although it may refuse to receive output at a higher voltage than justified by the total output in a socio-economic context. The optimal grid solution in a socio-economic context in the collective grid will be de-

fined by the grid company or transmission company, when the size of the wind farm has been decided with the winning tender and establishment of the concession agreement.

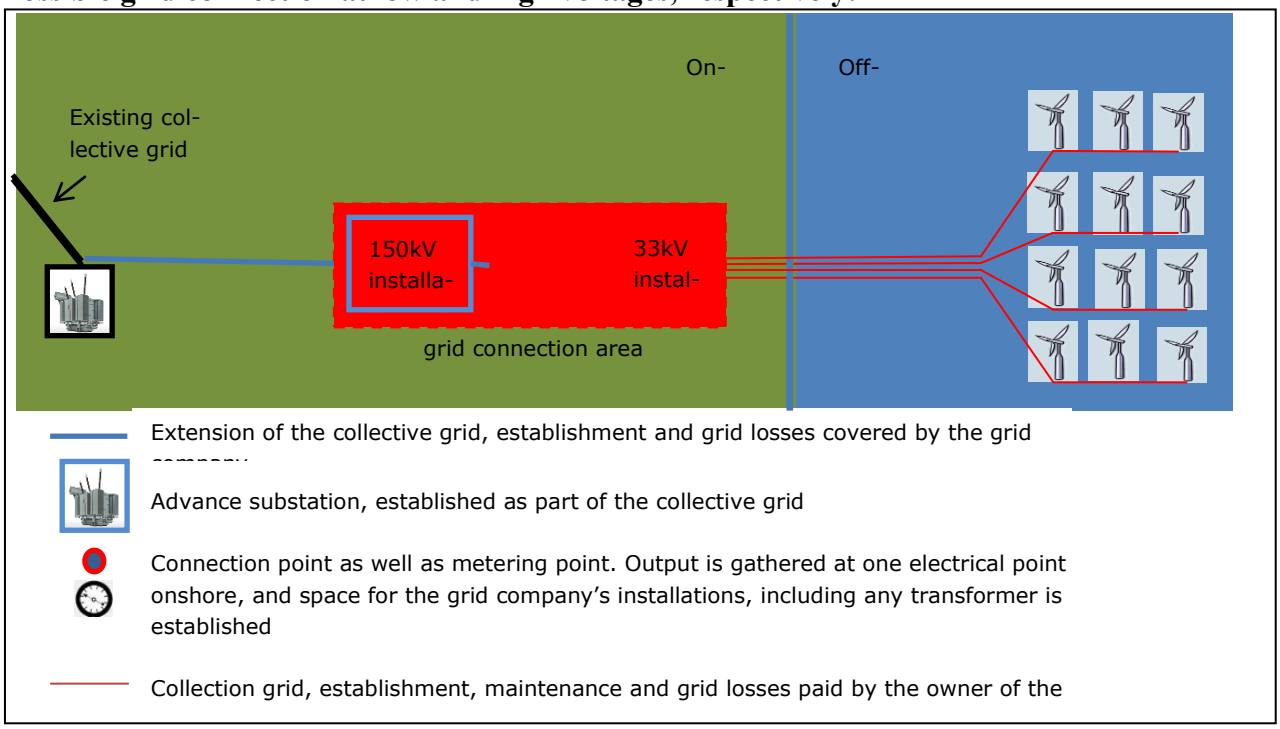
There are primarily the following scenarios:

- If the output is supplied at a relatively low voltage in relation to the output and distance to the existing grid, it is likely that, due to the grid losses in the collective grid, an advance substation will have to be established at the connection point. (For planning reasons this is not possible at North Sea (south).)

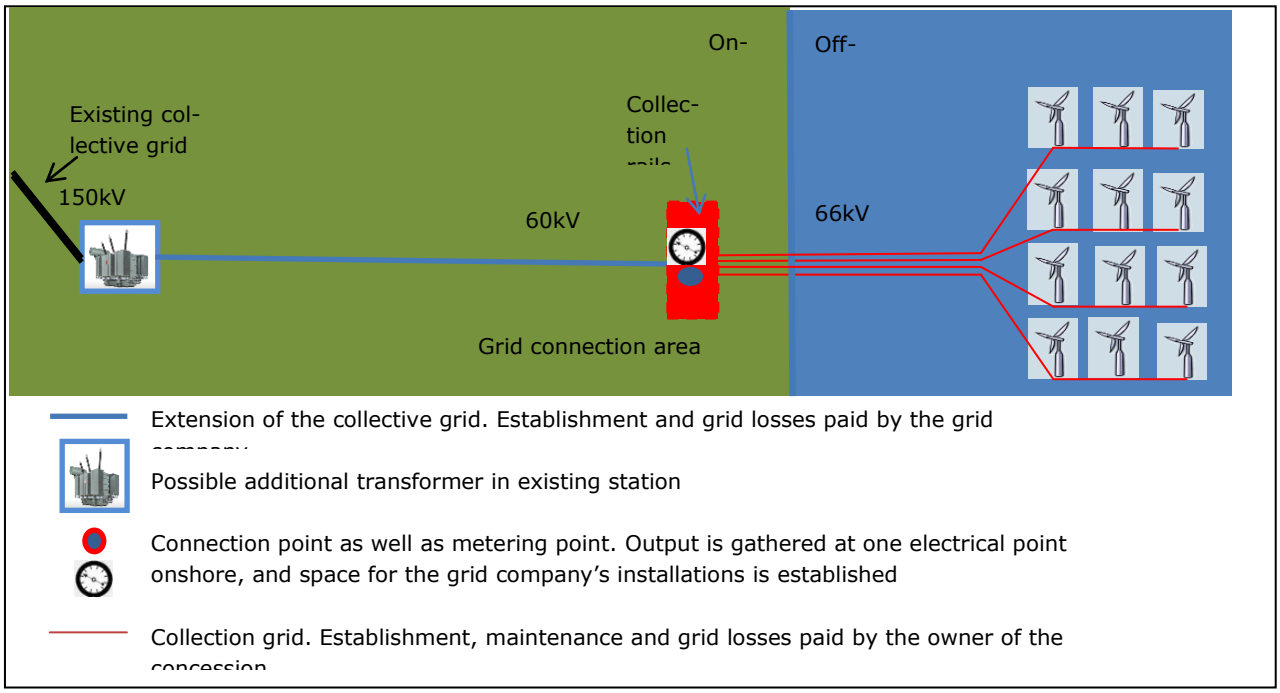
- If the output is supplied at an adequately high voltage in relation to the output and distance to the existing grid, there will be no need for transformation at the connection point. However, initially, the output will still have to be supplied at one electrical point, so that the grid company or transmission company can freely dimension the onshore cables in accordance with socio-economic principles.

The principle means that the partners are free to optimise their own grids. If situations should arise in which costs allocation is a barrier to the optimal solution, the partners are free to negotiate any compensation.

Possible grid connection at low and high voltages, respectively:



Example for supply of total output of 33 kV, and where, because of grid losses in the collective grid, it is necessary to establish an advance 150/33 kV substation.



Example for supply of total output of 60 kV, and where it is optimal in a socio-economic context to transport the output at 60kV onwards to an existing station.

Location of metering point
The metering point for grid losses for production from the offshore wind farm is at the connection point.

Security and compensation factors in the distribution grid
Dimensioning of the collective grid is on the basis of a socio-economic perspective in which establishment, operation, maintenance, grid losses and risk of breakdown are taken into consideration. The grid company is not liable for financial losses imposed on the concession owner because of delays in grid connection or breakdowns in the distribution grid. The grid company is, however, responsible for implementing the required grid reinforcement without undue delay and it is also responsible for rectifying any faults in the grid without undue delay.

Security and compensation factors in the transmission grid
The owner of the concession can be compensated, see section 35, see section 34(3) of the Promotion of Renewable Energy Act for breakdowns in the transmission grid from the connection point and in the underlying transmission grid, i.e. breakdowns in the transformer(s), collective collection grid, and the underlying collective electricity supply grid.

Establishment of cable routing onshore and security
The owner of the concession is to negotiate with and compensate local land owners, if the cable routing onshore is to run through their land. This will probably be done in collaboration with the local grid company. Up to and including the connection point, this is the responsibility of the concession owner. Costs linked with the process or compensation for land owners must be paid by the owner of the concession.

If production from the owner of the concession is to go into the distribution grid, i.e. below 100kV (this will usually be for wind farms of 100MW or less), the owner of the concession must provide a bank guarantee corresponding to the total costs of the local grid company. The bank guarantee must be submitted as security for completion of the project and it will be released when the first kWh is supplied to the collective grid.

If production from the owner of the concession is to go directly into the transmission grid, i.e. above 100 kV (usually be for wind farms larger than 100 MW), Energinet.dk will take over responsibility for transformation from the connection point, and in this case no bank guarantee for the project will be necessary. In the event that the concession lapses, Energinet.dk will be compensated via the retention penalty.