SUMMARY

Electricity is being transported over large and small distances to consumers. For this purpose, transmission and distribution networks have been designed and built. Transmission grids, in general, transport bulk amounts of power along large distances from a limited number of large producers to a small amount of consumers. Often, these consumers are distribution companies, including DNO's, that distribute the electricity to other consumers. Via their distribution grids, the electricity is delivered to a large number of small consumers.

Because of the mechanisms mentioned before, transmission and distribution grids differ in type, design and usage. The question remains what are transmission grids and what are distribution grids and, subsequently, what should be the boundaries of control between TSO and DNO's in order to maximize the contribution to the social objectives of the electricity grids.
By order of TenneT, the Dutch TSO, KEMA has analyzed the Dutch situation.

The analysis provides answers to the following questions:

- What is the optimal separation method to make distinction between the Dutch transmission and distribution grids?
- Which boundary of control maximizes the contribution to the social objectives?

To answer these questions, the following approach has been undertaken.
On the basis of objectifiable and non-objectifiable characteristics of the transmission and distribution grids, a number of separation methods are considered. It has appeared that separation based on voltage level is most applicable, because of clarity, understandability, sustainability and international consistency.

Four social objects have been identified, in order of importance:

- Security of supply;
- Market facilitation;
- Cost efficiency for network operators;
- Supervision by the regulator.

An analysis has been made of the impact and effects of the various separation methods. Additionally, the optimal boundary of control has been identified.

The analysis shows that security of supply is mostly availed by central control and management of grids that have been designed and operated in a redundant manner, that have an interlocal impact and that can mutually support each other. That way, disturbances will not always lead to interruptions of supply, interruptions can be detected at an early stage, the impact of the disturbance can be limited and short communication lines will reduce the restoration time.

Additionally, market facilitation by the network operators is benefited by making the connection philosophy and the related tariffs, for connections that are larger than 10 MVA, more uniform. The connection process will become more transparent because only one network operator is involved. This network operator has no commercial interests. Furthermore, communication related to system operations will be simplified if the transmission network operator can communicate directly with the large producers and consumers in case of emergencies.

An integral design view and philosophy that comprises all relevant voltage levels may introduce considerable cost reductions. Also, the number of control centers may be reduced. Again, this relates to those grids that cohere and mutually support each other.

The ability of the regulator to supervise network operators is mainly affected by the possibility to compare their grids. Supervision will become easier if networks are better comparable and the comparison is not distorted by the presence or absence of a transmission grid.

The analysis has shown that those grids that contribute to the social objectives mentioned are generally grids with a voltage level of 50 kV and up. Naturally, there are exceptions to this very generic conclusion. In particular, these exceptions can be found in some of the 20, 23 and 25 kV grids and smaller parts of the 50 kV grids. These (parts of the) grids, however, give rise to a rather small distortion of the general picture, as shown in figure S.1.

The conclusion is illustrated qualitatively in figure S.1. The social objectives are scaled to a weight factor that KEMA and TenneT have agreed upon. Security of supply is most important (40%), followed by market facilitation (30%), cost efficiency (20%) and supervision (10%). This graph clearly shows that the best boundary can be drawn between the grids operated at 20/23/25 and 50kV.

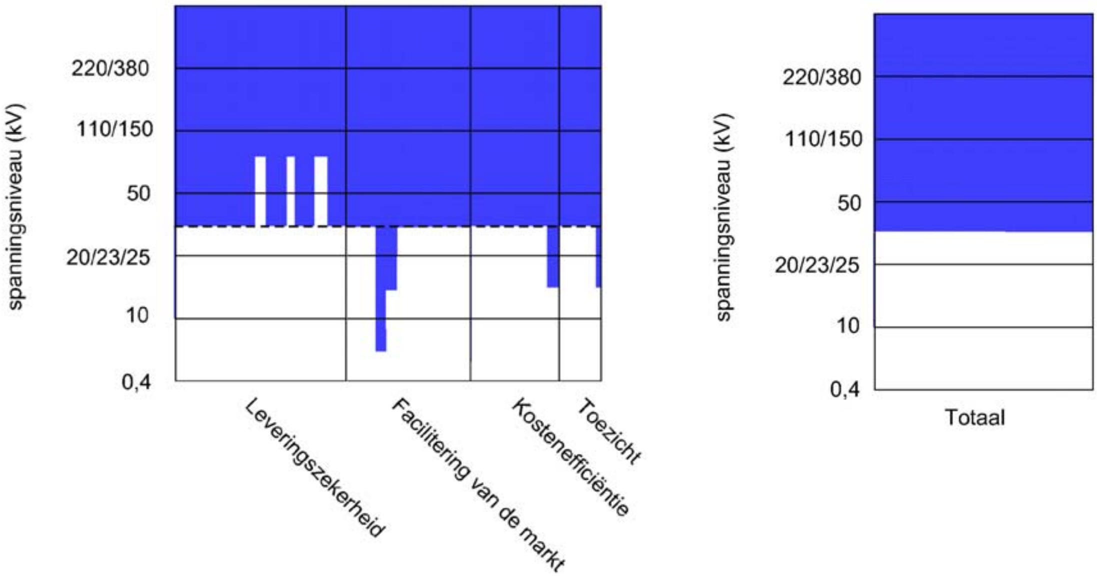

Figure S.1 Qualitative reflection of the separative boundary between transmission and distribution grids.

According to the - analysis described above, KEMA concludes that:

- A separation method should be based on voltage level;
- Grids with a voltage level of 50 kV and higher should be considered as transmission grids;
- Grids with a voltage level of lower that 50 kV should be considered distribution grids.