

The benefits of an interconnection line between Hiiumaa and the mainland

Technical assistance for Hiiumaa, Estonia

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In 2014, a socio-economic and technical preliminary study commissioned by Elering AS (Estonian TSO) and carried out by Civitta Eesti AS with the objective of improving the security of electricity supply in Hiiumaa as well as the socio-economic impact alternative solutions, led to the following options:

- Elektrilevi OÜ (DSO of the island) reinforces the existing medium voltage power grid in Hiiumaa, including the installation of voltage control equipment.
- In addition to the existing 35 kV cable lines, the 110 kV Leisi-Nord (Kâina) -Kârdla transmission line will be built between Saaremaa and Hiiumaa.
- a 110 kV cable will be built between the mainland and Hiiumaa, from the Aulepa or Haapsalu substation, with a 110 kV substation (Kârdla or Kâina). Construction can begin after reinforcements to the West Estonia power grid, which will be approximately completed in 2025.

It is mainly this third option that the municipality of the island of Hiiumaa preferred. However, in the current National Maritime Solution Plan (MSP), the island of Hiiumaa has been refused its request for connection to the Estonian TSO. The latter does not wish to extend its transport power grid from the mainland to the island. The National Maritime Solution Plan considers that it would not be economically feasible to connect the island and that it would be sufficient for the island of Hiiumaa to strengthen its current 35 kV micro-grid with a 110 kV connection via the neighbouring island of Saaremaa. However, the authorities in Hiiumaa believe in the benefits of an interconnection to the continental power grid. With the wider development of renewable energies, the island of Hiiumaa plans to install a cable between Hiiumaa and the mainland around 2030.

The analysis of the costs and benefits of a power grid expansion is usually conveyed through technical-economic calculations using the Net Present Value. However, various other non-monetisable and monetisable economic and technical aspects should be considered in planning an interconnection, such as maximum power transfer limits, system losses, N-1 contingency, fault currents, stability transient, protection setting and discrimination.

As part of the project leading to this report, DigSILENT PowerFactory simulation software was used to study the behaviour of the Hiiumaa grid as influenced in the presence of an interconnection line with the continental grid. Two main scenarios were considered for the grid study:

1. One baseline scenario for 2020 consumption case,
2. One baseline scenario for 2040 consumption case.

According to load flow studies, the system voltage and load profile remain within normal operating limits with the addition of the 110 kV interconnection with the continental grid. The simple contingency carried out showed that it was necessary to reinforce all the existing transmission lines of the Hiiumaa power grid, to install automatic voltage regulators and reactive power compensators to reduce energy and voltage losses.

The calculation of short-circuit currents does not affect the choice and ratings of circuit breakers.

However, it should be noted that the lack of data essential for certain calculations can have an impact on the development of the studies. This is the case with protection and coordination studies, as well as stability studies.

On the other hand, despite the absence of the data necessary for the transient stability study and even if the Hiiumaa electrical network does not include any synchronous generator on an industrial scale, it seems that the stability problem disappears after the construction of the new transmission line. Lowering the system impedances will reduce the electrical distance from the generating units and establish a closer link between the cogeneration system and the utilities. The effectiveness of reducing impedances to increase system stability can be easily determined using modern computer programmes.

Additional work would be suggested to study the impact of the projected interconnection line on the installation and adjustment of the protection of the system.

We also recommend analysing economically and technically the effects of the implementation of the following three possible alternatives: greater renewable production, hydraulic storage by pumping and electric vehicles on the island of Hiiumaa.

Currently, Hiiumaa Island is hampered by its low power generation capacity, which is not only a source of immediate concern, but also a risk to its future economic growth. The municipality is expected to put in place short-term projects to help increase the island's energy production and harness its green energy potential. These projects will also contribute to the socio-economic development of the communities