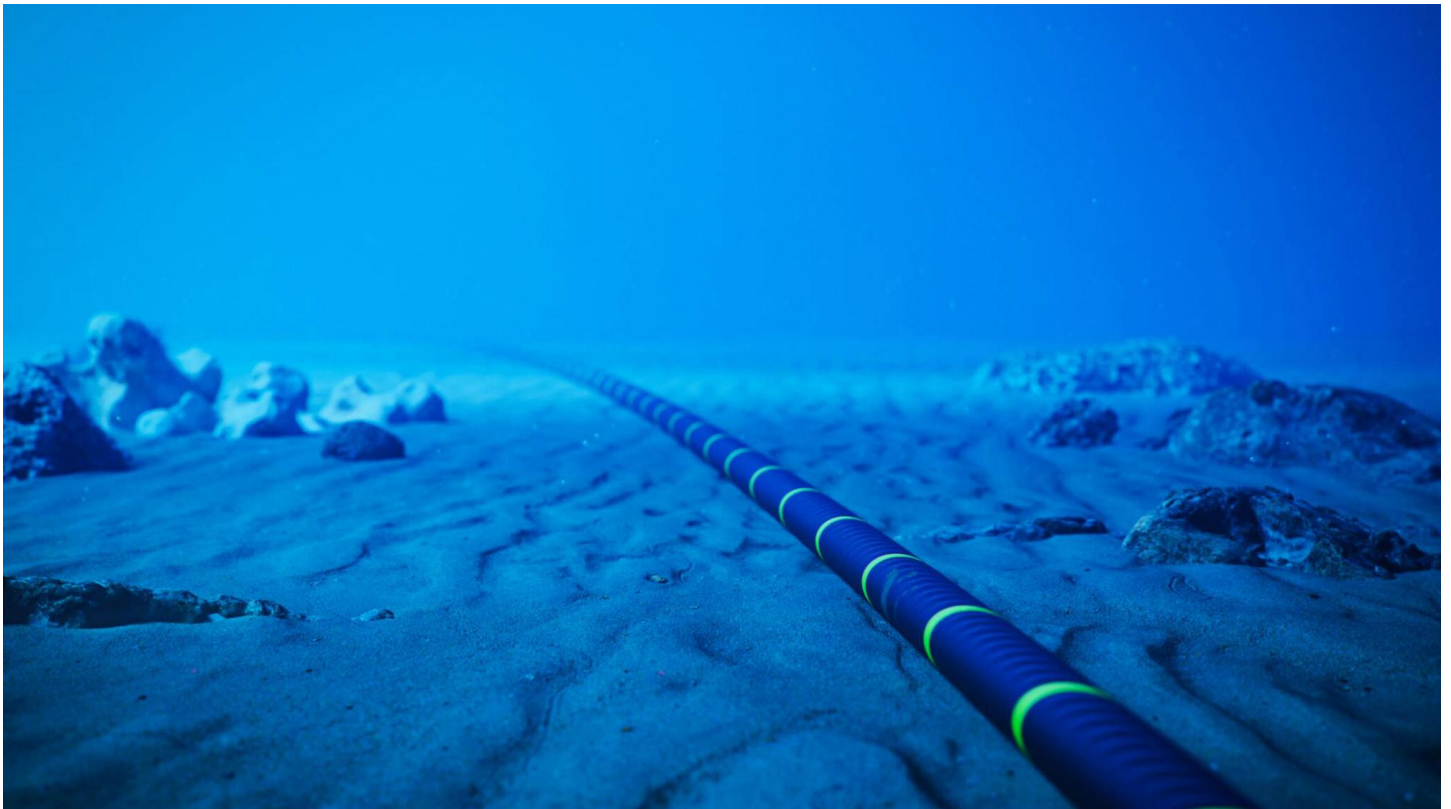


Case Study

The Importance of Precision Monitoring in Early Fault Detection and Grid Disturbances.

The **Estlink-2 Underwater Cable Break** Case and Its Implications for the Norwegian Power Grid



Espec's [Power Quality Analyzers](#), with their precision monitoring and fault detection capabilities, played a key role in identifying and analyzing the effects of the Estlink 2 underwater cable break and its impact on the interconnected grid in the Baltic Sea on the Norwegian power grid. [PQE/PQS AS](#), Elspec's agent in the region, used these tools to provide accurate insights for assessing the event's impact on the Norwegian power system.

The Customer Situation

On December 25, 2024, a cable break occurred on Estlink 2, a submarine power cable connecting Finland and Estonia. This disruption significantly reduced the transmission capacity between the two countries, dropping from 1016 MW to 358 MW. Given recent geopolitical tensions in the Baltic Sea region, there were concerns that this incident could be the result of sabotage.

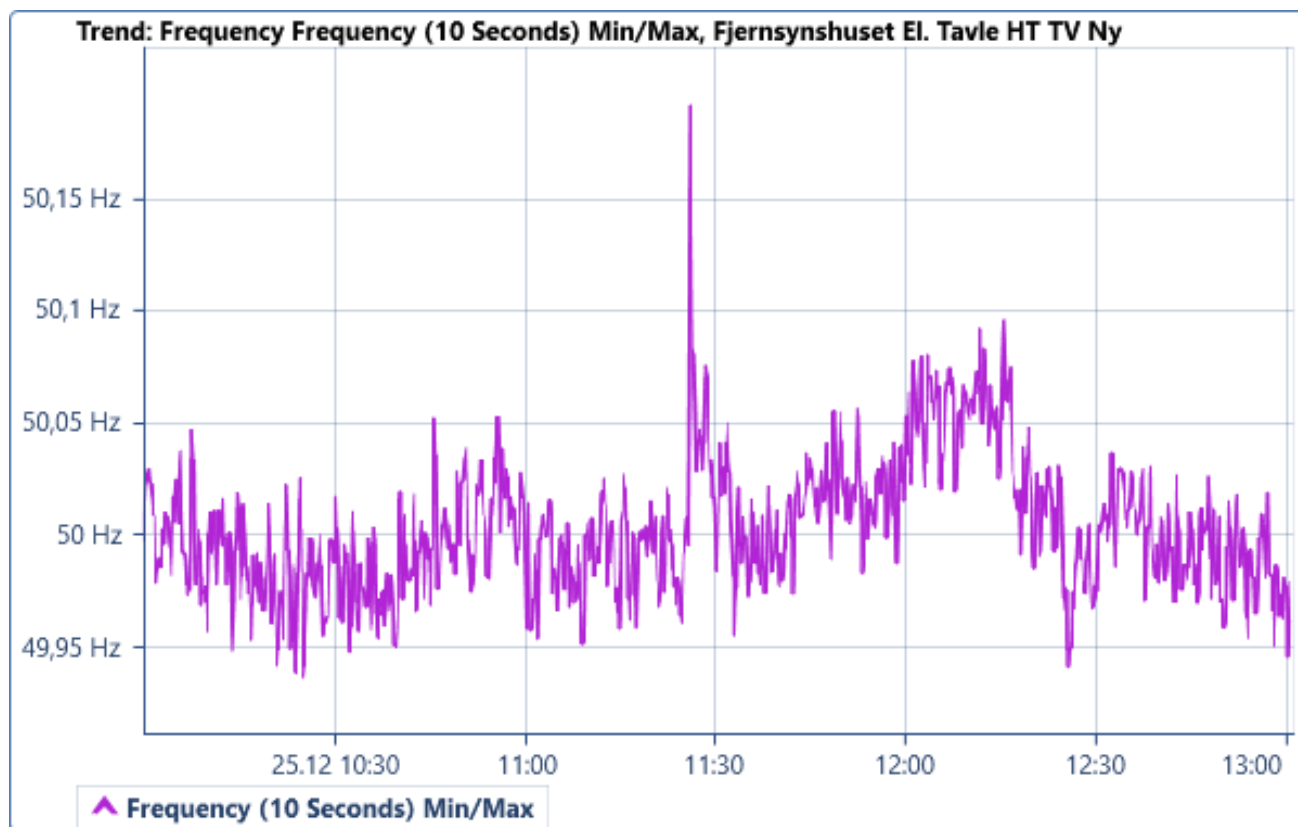
As part of the monitoring efforts in Norway, [PQE/PQS AS](#), a leading company specializes in electrical safety in Norway and Elspec's agent in this region, revealed this incident effects on the Norwegian power grid and assessed the potential consequences, using the data from Elspec's G4K fixed Analyzers and G4500 Portable Analyzers connected to several points of the Norwegian electrical system.



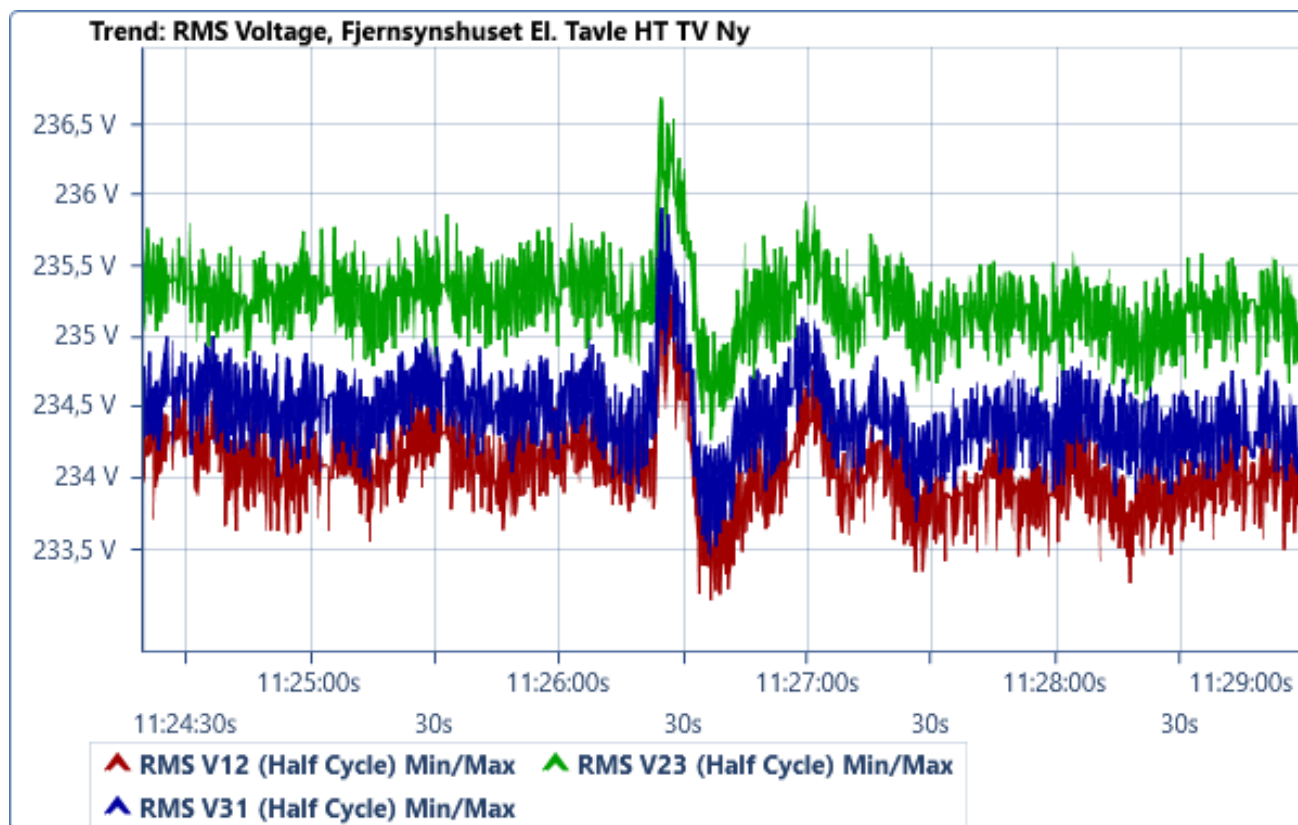
What Happened in the Power Grid?

Norway, Sweden and Finland are interconnected within a shared power grid operating at the same frequency, further linked to other countries via submarine power cables. When the Estlink 2 cable failed, the following occurred:

- **Frequency Changes:** Monitoring instruments across Norway, from Oslo to Tromsø, recorded a noticeable frequency increase as 650 MW of load was disconnected from the grid.



- **Voltage Changes:** A slight voltage increase was observed, though these variations remained within normal limits.

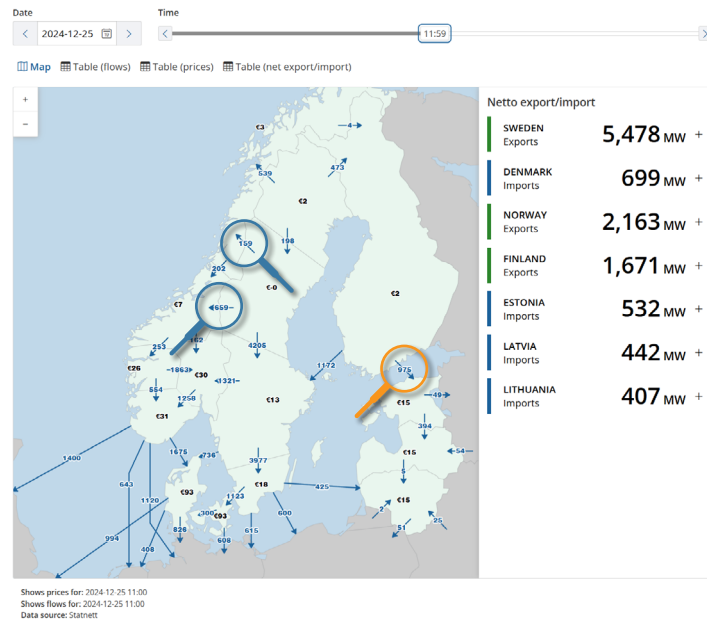


- **Stable Conditions:** Despite these fluctuations, the changes were minimal, highlighting the robustness of the interconnected power grid in Norway, Sweden, and Finland.

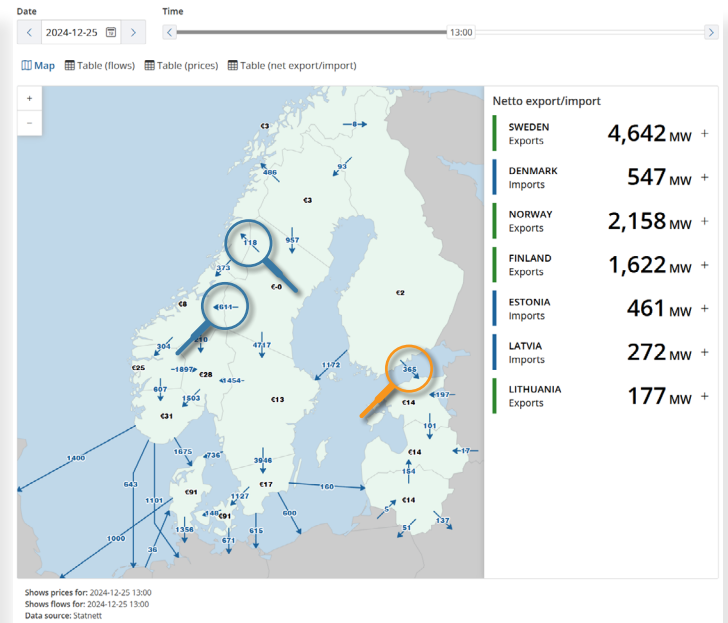
The Importance of Precision Monitoring and Fault Detection

While the incident didn't have a significant practical impact on Norway's power supply, it underscores an important point: Since the frequency and voltage changes fell within the tolerance levels (typically set by power grid engineers) of standard electrical equipment, many analyzers would have missed these subtle fluctuations, potentially overlooking the incident entirely. The images below, sourced from the Swedish National Grid website, highlight how the ability to detect such events varied across different countries in the region.

Before the incident



During the incident



The data reveals a noticeable drop in power flow from Finland to Estonia, from 975 MW to 365 MW, while the change in power flow to Norway was almost imperceptible—dropping from 659 MW to 611 MW and from 159 MW to 118 MW. Elspec's advanced monitoring capabilities, however, successfully recorded even these minor changes through continuous waveform recording at up to 1024 samples per cycle. This enabled Elspec's analyzers to provide detailed insights and help PQE/PQS uncover this incident even from the Norwegian electrical network data. Elspec's [power quality analyzers](#), along with the associated software, are particularly effective for monitoring high-voltage grids and analyzing events. Key advantages include:

Detailed Logging: These Analyzers continuously record all waveform signals, enabling comprehensive analysis of all events, even minor fluctuations that may not trigger traditional alarms.

Accurate Fault Analysis: Even distant events can be analyzed with high precision, thanks to the advanced measurement principles used by Elspec's technology.

Data Overview: While Elspec's analyzers record extensive data, overview remains important. Elspec's [power management](#) software, PQSCADA Sapphire, enable access to more than 5000 parameters for best view and investigation.

Summary

As power grids become larger and more interconnected, understanding how faults propagate is increasingly critical. Elspec's power quality analyzers have proven to be invaluable tools for this type of analysis, providing precision and reliable data for insights that help manage and mitigate unexpected events.



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