Vattenfall Distribution – Dynamic line rating

Participants: Vattenfall Distribution, USi, GE
Categories: Transmission enhancement applications, Renewable and distributed generation integration
Time plan: Started in 2012 as a project, now integrated in daily operations
Contact person: Arne Bergström, Vattenfall Distribution
Location: Various locations in Vattenfall Distribution's grid
Possible to visit: Yes

Background

Around 2008, Vattenfall started receiving an increased number of requests to connect large amounts of wind power to their grid. This was often to be done in areas where the grid is weak, and Vattenfall wanted to find a way to accommodate these connections in the existing grid. One of the main reasons for this was that the processes to receive permission to rebuild the grid are quite long. There were also economic implications, as it is less costly to use present infrastructure than to build new, at least in a transition phase. While dynamic line rating started from the need to be able to connect large producers to weak parts of the grid, it can also be used in other contexts, such as faster power availability in congested areas.

Vattenfall then chose to try two different technologies which allows for the grid to sustain a heavier load than its static limit. The static limit is set to meet worst-case weather scenario for the actual period, which often leads to that the power lines can transfer significantly more power than the static limit. This is particularly true in windy conditions, where the line is cooled by the surrounding elements.

Implementation of the project

Vattenfall tried two different DLR-solutions in parallel.

One of them was the Power Donut by USi, which is a sensor that is installed onto the power line. It measures the conductor temperature as well as the current. Data from the measure sites is transferred to Vattenfall control center where the real time DLR is calculated by using well known algorithms to decide how much power each line can carry. The data is available to the operators in real time.

The other solution tested by Vattenfall was delivered by GE, and instead relies on local, real time weather data to calculate the upper limit for the line load. In this solution, weather stations are placed roughly 10-20 km apart along the relevant power line, and the data from the stations is used to calculate the ability to put an extra power load on the line. This system is independent of the line itself, but care needs to be taken where the weather stations are placed. They should ideally be placed in areas where local conditions are not good for chilling the lines, such as dense forests or valleys. There might also be practical issues, such as the access to roads, communication and possibilities for LV supply.

After an evaluation period, Vattenfall concluded that the GE solution is most useful for their needs, and decisions were taken to continue with the GE solution.

Benefits

By using dynamic line rating, Vattenfall can optimize investments in new infrastructure by using the lines that are already present to a larger extent. It also allows for quicker changes in the grid, as extended processes to build new infrastructure can be avoided.

Scalability

In principle, dynamic line rating could be used for any number of lines. In reality, however, it is probable that the usability is limited to a handful of lines under certain conditions.

Interoperability

Dynamic line rating is possible to implement in the present grid without any modifications to the grid itself. Dynamic line rating at one line, can however have implications on surrounding grid infrastructure, which needs to be taken into the equation.

Investment horizon

In relation to constructing a new line, the dynamic line rating system is not costly, and the payback time is very short.

International potential

Dynamic line rating is in itself not unique and is used at other locations both in Europe and North America. It is however a fairly new technology on regional and distribution level, and Vattenfall as an early adopter can give valuable input to other utilities that want to try dynamic line rating.