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Technical report on unscheduled flows in the Swiss grid

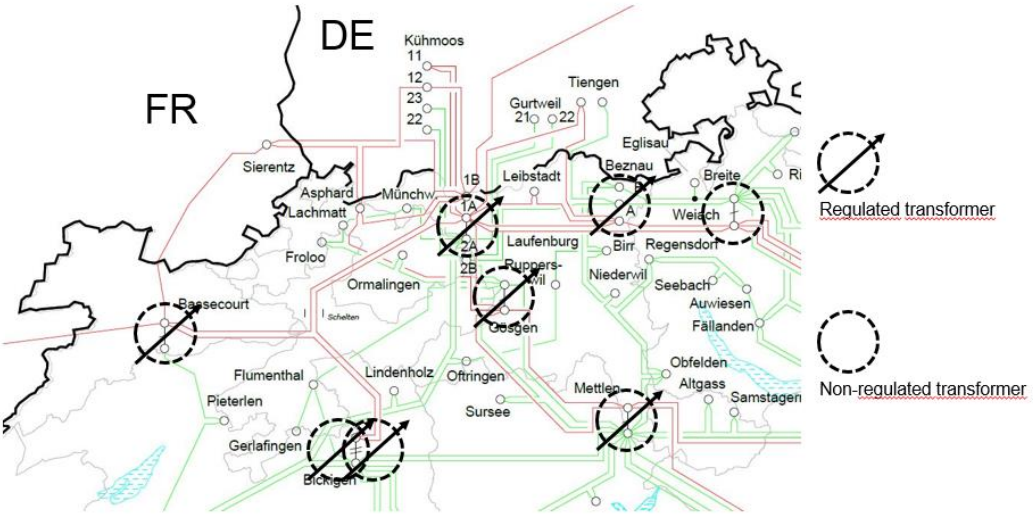
1 Introduction and summary

This document intends to explain the issues regarding the security of supply which Switzerland is facing due to the increased border transmission capacity within the CWE region since the introduction of the CWE flow-based market-coupling. It is based on several documents elaborated by the CWE TSOs in cooperation with the Swiss TSO Swissgrid and is meant as a help for the CWE NRAs in better understanding the situation.

By considering the Swiss critical elements during the CWE capacity calculation not only the Swiss grid security will be improved, but also the security of supply of the neighboring countries, especially France and Italy. The inclusion of Swiss constraints will only affect the cross-zonal capacity within CWE under certain grid conditions, mainly in low load situations in winter. No impact will be seen during high load situations, which are critical in terms of security of supply and wholesale prices. Furthermore, the inclusion of Swiss constraints will never lead to lower cross-zonal capacities than the NTC-values defined before the introduction of flow-based market-coupling.

2 The Swiss transmission grid in the north-west

The transmission grid of Switzerland is heavily linked to its neighbored countries by means of several cross-border lines on both 380 kV and 220 kV level to Austria, Germany, France and Italy. The bulk of the Swiss import capacity from the CWE countries is concentrated in the north-west of Switzerland:



The biggest amount of imports at the north-western border from Germany and France happens on the interconnections at 380 kV level. However, exports from Switzerland to France and Italy at the south-western border rather happen on the 220 kV level. Moreover, the only 380 kV border line to France in the south-west is not connected to any other Swiss 380 kV line, but to a coupling transformer 380/220

kV. Thus the transit through Switzerland from Germany and northern France to southern France and western Italy is increasing the loading of the 380/220 kV transformers shown in the figure above. In addditition these transformers are loaded for the import of Switzerland.

As most of the northern transformers are regulated (phase-shift functionality), the load flow can be controlled to a certain degree. The regulated transformers can be relieved as long as other transformers are not fully loaded. In high load situations all transformers are almost equally loaded. Thus the northern transformers together can be seen as one single virtual transformer.

The 380 kV cross-border lines have a much higher physical capacity as this transformation, thus the typically limiting elements in the northern Swiss transmission grid are this 380/220 kV transformation and also the 220 kV lines. As this transformation does not only supply Switzerland, but also southern France and western Italy via the 220 kV lines, it is not only relevant for the security of supply of Switzerland, but also for the security of supply of both these countries.

3 Influence of the flow-based market-coupling

It is a well-known fact in the highly meshed European transmission grid that the physical flow over the different national borders only partly corresponds to the traded energy between these borders. The CWE TSOs together with Swissgrid have shown that roughly 30% of a cross-border trade from CWE to France flows physically through Switzerland. This was presented by the CWE TSOs in the CWE NRA meeting in April 2017 in Vienna. This results was also acknowledged inside the ACER PTDF study.

Also in the previous NTC-based regime these 30% unscheduled flows flew through Switzerland. However the NTC-values were agreed between the countries in a coordinated approach, where such unscheduled flows were considered (so-called NTC “C-Function” from Germany). Thus these 30% non-commercial flows did not lead to an overloading of Swiss elements. If the NTC-values in the region (CWE and Switzerland) were fully used, the northern Swiss elements were typically loaded close to (but not above) 100% in (N-1), which proves that the determination of the NTC was correct.

In some situations, the capacity from CWE to France (i.e. German/French and Belgian/French borders) increased up to 4000 MW with the introduction of the flow-based market-coupling compared to the previous NTC-based calculation. If this capacity is now strongly used under the same conditions as before, the loading of the northern Swiss 380/220 kV transformation therefore increases and the transformers sometimes are no longer (N-1) secure. Thus the flow-based capacity increase is endangering the security of supply of Switzerland and also – as shown above – the security of supply of France and Italy in case of a cascading effect.

In case of a sudden tripping of an element, which induces an overloading of one of these transformers, it would be a realistic scenario that the protection of that transformer turns the transformer off and thus could lead to an overload on other transformers or lines and so forth. So the threat of a cascading effect is real.

4 Typical load flow situations

The (N-1) security criterion is only violated if France and Switzerland are both strongly importing from other CWE countries. This does not occur in all situations:

4.1 High load

In a typical high load situation in the CWE region and Switzerland, the production of the Swiss storage power plants in the Alps is high. In this situation, Switzerland exports in summer times and only minor imports in winter times. Thus there is no risk of transformer overload: for all Swiss elements close to the northern border, the (N-1) criterion is fulfilled.

This is the typical situation, where countries with a predominantly base production such as France or Belgium need to import to cover their high load, i.e. to guarantee their security of supply and their own national consumption. These cases happen especially during peak hours in winter – as experienced this year again.

4.2 Low load

In the winter half year during the night, both France and Switzerland sometimes highly import simultaneously. This is the situation, where (N-1) violations might happen in Switzerland. It is important to note, that the import of France in such situations is often used for transit, especially towards Italy. However, also situations can occur where France is “really” importing, but still has enough margin left to cover the own load.

According to the CWE TSOs and Swissgrid analysis, this situation occurred during approximately 240 hours per year in the period analyzed.

In these hours, there is no real security of supply issue in terms of scarcity. The markets in CWE are often coupled and have the same very low price level.

5 Consideration in capacity calculation

If, as requested by Switzerland, the northern transformation would be considered in the CWE capacity calculation in an appropriate way, it is expected that this would lead to:

- No change in high load situations
- A certain reduction of CWE to France capacity in low load situations in winter (during the approx. 240 hours described above)

In low load situation, no negative influence on the French (or CWE in general) security of supply is expected as France (and also Belgium) has enough production capacity to cover its own load and domestic consumption.

Thus, by considering the critical Swiss elements, the grid security of Switzerland (and consequently the security of supply of France and Italy) is secured resp. improved without negative influence on the security of supply for any other country.

The TSOs have shown their commitment in finding an appropriate way on how to consider the Swiss critical elements.

Additionally, the capacity from CWE to France or Belgium shall never drop below the previous NTC-values due to consideration of the Swiss critical elements. The NTC-values had been calculated to guarantee the (N-1) security of the region (CWE and Switzerland). A minimum increase could even be coordinately agreed upon (e.g. guaranteeing in such situations a certain increase compared to the previous NTC-values).

6 Redispatch as countermeasure

Usually, the countermeasure for a local congestion is redispatch. A national redispatch within Switzerland cannot solve the situation. As explained above, all 380/220 kV transformers in the northern region are in (N-1) close to 100%. A redispatch within Switzerland might relieve for example a transformer in the west of Switzerland, but consequently would lead to an overload of a transformer in the east of Switzerland and vice versa.

The transformer overloading could be relieved by an international redispatch with e.g. Germany. In this case, a Swiss power plant would have to increase its production while a German power plant would decrease its production.

The most flexible power plants in Switzerland are the storage lakes in the Alps. By increasing hydro storage production in low load times in winter, the water used will no longer be available for high load times. This applies not least for potential scarcity situations in the CWE countries or Italy.

In general, high load in winter is the most critical situation for the security of supply. Thus, with international redispatch as a countermeasure, the security of supply would decrease not only for Switzerland, but also for the whole CWE region and Italy.

An example of the importance of the Swiss storage lakes for the regional security of supply has been the situation in the cold January 2017, when the situation was critical especially in France and Belgium.

At this time, Switzerland strongly contributed to relieve the tense situation by emptying the storage lakes and exporting first of all to France. Additional intraday capacity above usual values was allocated on the border Switzerland to France, in order to secure the France adequacy in peak hours. However such a contribution is only possible if enough water is stored in the lakes and this is endangered when the water has to be increasingly used in low load situations.

7 Proposal how to handle Swiss CBCOs[1]

Based on the explanations above, it is proposed to include Swiss CBCOs during the flow-based computation to check the Swiss security of supply by including the 30% of transit flow induced by trades from CWE to France. Moreover, to not penalize the trades inside the CWE region and also show advantages of the flow-based market-coupling inside the CWE region it is also proposed to guarantee an increase of the capacity CWE to France in comparison with the previous NTC-values

Concretely, during the flow-based computation process the Swiss CBCOs will be taken into account, only as far as the resulting exchanges stay above the previous NTC-values plus a certain coordinated threshold – for example 500 MW.

To repeat – in any case, the capacity from CWE to France or Belgium shall never drop below the previous NTC-values plus the threshold due to consideration of the Swiss critical elements. This is due to the fact that the NTC-values have been derived in a way which overall guaranteed the regional (N-1) security.

8 Political situation

There is no intergovernmental agreement yet on electricity cooperation between the European Union and Switzerland. As long as this is not settled, Switzerland is excluded from certain power market functionalities due to some clauses in the network codes.

However, the exclusion clauses are limited to market issues and do not apply to any security of supply issues. This interpretation was confirmed orally by DG Energy to Swissgrid and by ACER to ElCom. It is also supported by the clause within EB code, whereupon Switzerland shall be included into the European balancing energy platforms even before an intergovernmental agreement is finalized *«if the exclusion of Switzerland may lead to unscheduled physical power flows via Switzerland endangering the system security of the region»*.

Including Swiss critical elements into the capacity calculation is at the core of security of supply which will remain at risk as long as Switzerland is not only excluded from market-coupling, but also from capacity calculation.

In ElCom's view, considering the critical Swiss elements in the CWE capacity calculation does not infringe any special Swiss clauses from the network codes or EU regulations.

[1] Critical branch – critical outage