

# **A PROPOSAL OF NEW METHOD FOR SOLVING CRITICAL DISTURBANCE IN INTERCONNECTED POWER SYSTEMS**

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## **ABSTRACT**

This article deals with the proposal of the new method for solving critical disturbance in the interconnected power systems. The method lies in the use of existing control reserves for limitation transit power flows, which may cause another spreading of the disturbance. The exemplary dynamic stimulations on the small test system PST16 are included in this paper.

## **1 INTRODUCTION**

The biggest problem of extensive defective states is inability of regulation transit power flows. These flows can change direction and size during the disturbances. The European power grids are operated with respect for n-1 criterion, but if bigger disturbance arise (international extent) there are no procedures for solving these problems and the disturbance can disperse furthermore. This is the cause of majority simultaneous disturbances in Europe.

One of a few possibilities to unload the overloaded network elements is the use of redispatch. By using the redispatch there is a drift towards the redistribution of the production in the regulation area in the way, so that it comes to unload of the overloaded components and it does not come to the change of the balance of the area at the same time. This way is almost useless at the big transit, because manipulation with the source in the transit power system does not influence the transit power flow enough and every other solutions influence the balance. Moreover, by shutdown of generation unit in some part of the network, we may lost a source of an active and reactive power, which could be used for restriction of the consequences of the disturbance in the case of the further spreading of the disturbance. Furthermore, there may not be enough suitably allocated sources in the power system, which could be used for redispatch.

The solving of these problems is to keep a special reserve of the control power in sufficient amount in every regulation area, which could be co-ordinately activated in the situations, which were described above. This would be very expensive, because using these reserves would be very rare. However, if we do not solve these cases, even if they are rare, may cause huge damage.

## 2 METHOD

There is a possibility to change the rules, which are valid nowadays and make the use of the current reserve possible for the interstate redispach. This would be short-term special solution, which would prevent spreading of the disturbance, and would give us precious time for solving the situation with the common means.

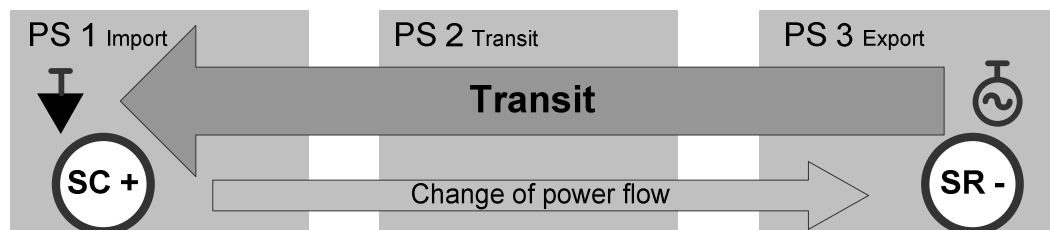
For the realization of the interstate redispach is necessary so that the reserves fulfil these conditions:

- Adequate speed of activation (spinning and quick- start reserves)
- Positive and negative control range
- Simply activation a deactivation
- Adequate range

These conditions are convenient only for reserves for secondary control, tertiary control and quick start reserves.

If some of the regulation areas are in a trouble, which cannot be solved with their own means, this regulation area will ask neighbouring regulation areas for a temporary change of the balance of the area. The extending of the required change of the area is decided by the affected area according their simulations, which come out of their current situation. In the same way it comes to the reversion of the planned balance of the area. Operating period of using secondary control reserves will be dependent on the agreement of the interested parties and on the level of the solving of the problem.

Naturally, the most efficient would be the manipulation with the sources in the area of overloaded element of the affected area. In some cases it would be possible to reduce the balance of the area by the shutdown of generation unit and to compensate power deficit from abroad, so that it comes to the fastest and the most effective unload of the overloaded element.



**Fig. 1:** *Principle of new method*

In the Fig. 1 is shown graphical presentation of the new method. If overload caused by transit power flow occurs in PS2, then PS2 request other PS to activation to activate the secondary control reserves in PS1 and PS3 to decrease transit power-flow and therefore decrease of network load in affected ES.

## 3 EXAMPLE

For the testing of the method was again used test system PST 16, in which were supplemented data needed for working of the primary and secondary control. The simulations itself were computed by software MODES, which is meant for transient stability stimulations.

To make in easier the implementation of all generation units both the primary and the secondary control was taken into account. Droop of generation units in primary control is 5%. Total control reserve of primary and secondary control in whole power grid is approximately 700 MW. This reserve is as compared with UCTE high, but in this case it is caused deliberately to compensate outage of generation unit of the big generation units.

Parameters of secondary controllers of regulation areas are:

Proportional constant  $\beta_i = 0.5$

Constant of integration  $T_{ri} = 100 s$

Sampling frequency of controller  $5 s$

Time constant for filtration ACE is  $40 s$

Initial state of the test system is described on the Fig. 2. The border profile between areas A and C was cut-off at 50 s. The total power flow on this profile loaded remaining connected profiles. This situation is shown and described on Fig. 3.

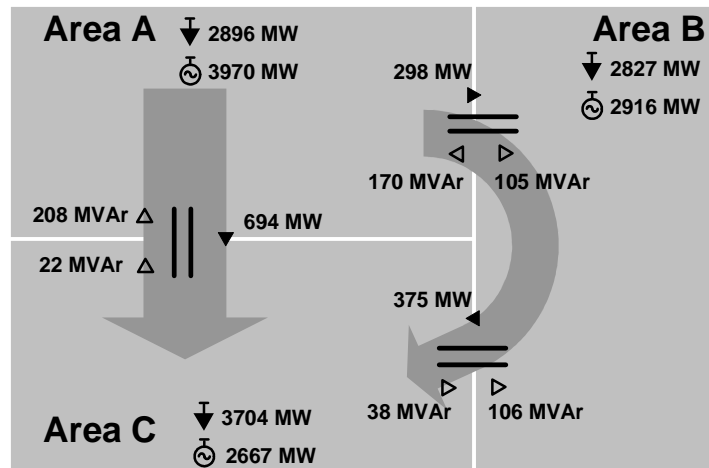


Fig. 2: Initial state

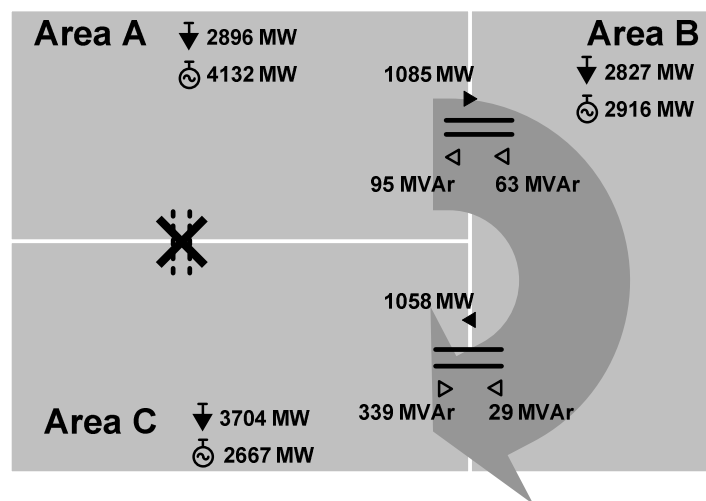
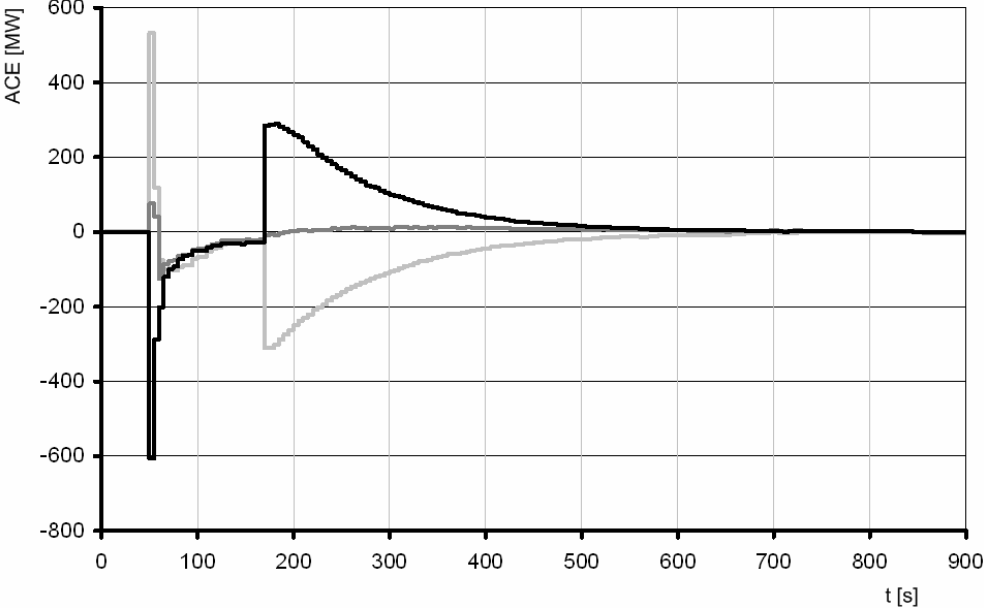


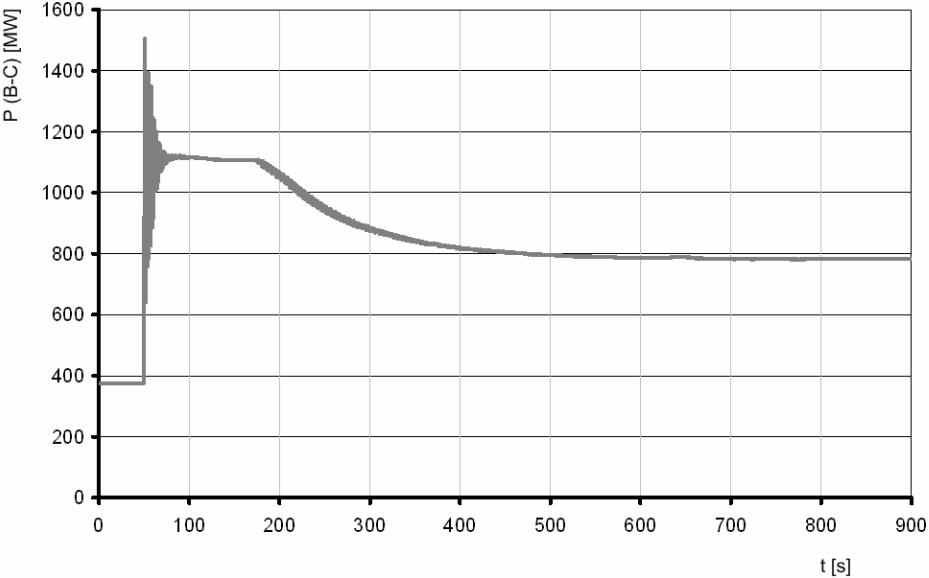
Fig. 3: After outage

The profile between areas B and C was overloaded due to the outage; there are only 220 kV lines. These lines were loaded on 102 %.

For unloading of the profile B-C, there was applied redispatch using secondary control reserves. Change of balance of area A and C was realised at 170 s. Load flow between both areas was decrease due to generation redispatch. Regulation process finished after 7 minutes. The overloaded profile was unloaded shortly after starting of regulation process.



**Fig. 4:** ACE of all areas



**Fig. 5:** Transit power flow through profile B-C

## 4 CONCLUSION

The new method, which may help to prevent the spreading of the disturbance in interconnected power system and with using the current reserve, was described in this paper/article. Using of this method is only sort – term solution. The main purpose of this method is to save time for solving the disturbance with standard methods.

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