The Short-Run Security-Constrained Economic Dispatch

By Olga Galland,
olgachu@kth.se, TELPM

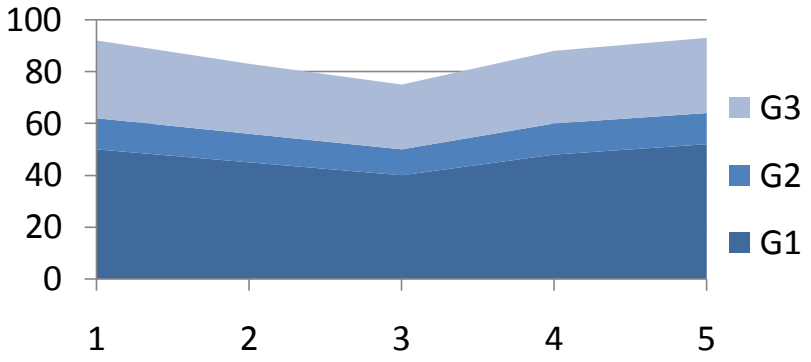
Supervised by
Dr. Mohammad R. Hesamzadeh,
mrhesamzadeh@kth.se

Background

In liberalized electricity markets, the outputs of controllable units must be defined at regular time intervals - *"dispatch intervals"*

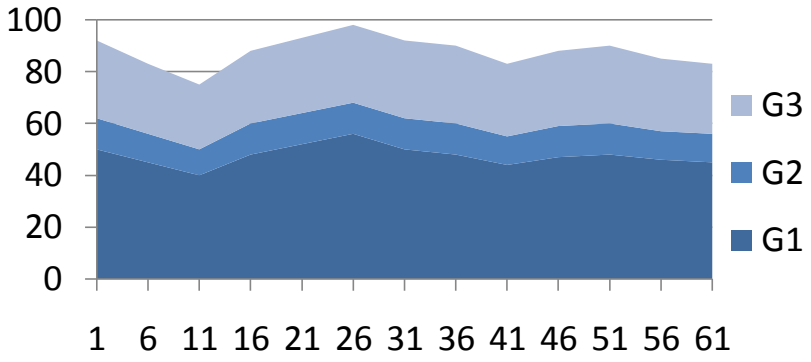
Examples of the existing dispatch intervals (DI):

In Europe – 1 hour



Dispatch of 3 generators (G) during 4 hours

In Australia – 5 minutes



Dispatch of 3 G during 1 hour
(the hour 1-2 of previous figure)

Demand and wind power capacity fluctuate a lot within DI

Supply-Demand balance is kept by G participating in frequency controls

Not all system physical limits are included in the existing dispatch models

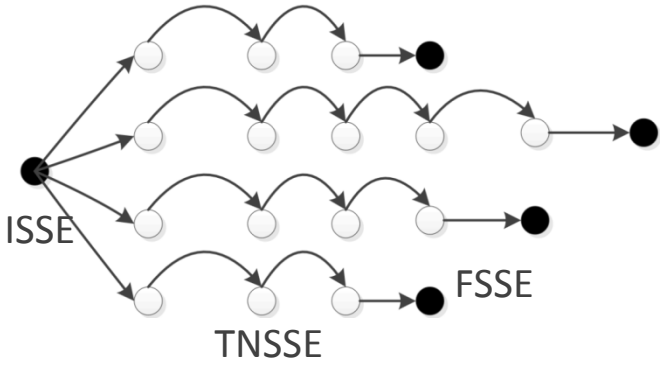
Dispatch of balancing services is *imperfect* and *inefficient*

In this master project dispatch of balancing services is proposed to be proceeded in an *economically efficient* manner, considering *physical limits* of the power system

Overview

In this Master thesis the concept of shot-run economic dispatch (SRED) is mathematically derived as a *linear programming (LP) problem.*

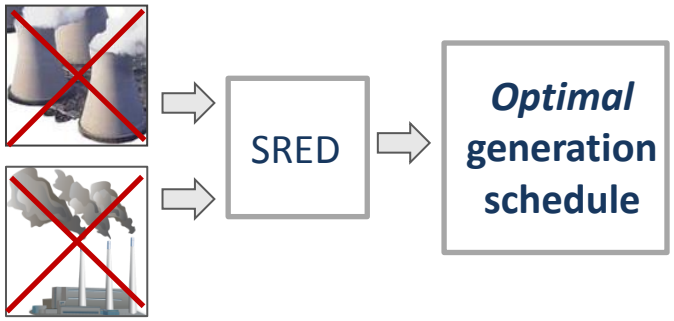
The concept SRED is formulated through *three stages* that model the state of power system *before*, *during*, and *after* contingency (disturbance of the supply-demand balance of power system) occurred:



- The initial steady state equilibrium (ISSE);
- The transition to a new steady state equilibrium (TNSSE);
- The final steady state equilibrium (FSSE).

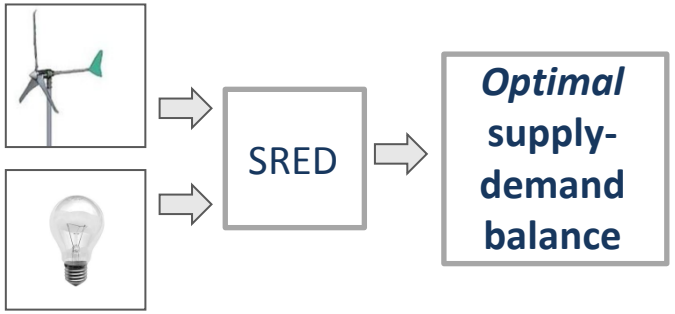
In this project the proposed formulation is implemented for two applications :

- The Power System Security



Credible contingency – low frequency contingency

- The Real Time Balancing Market



Demand and wind power fluctuation – high frequency contingency

Contribution

The proposed model was tested on 24 bus system for both applications:

- The Power System Security

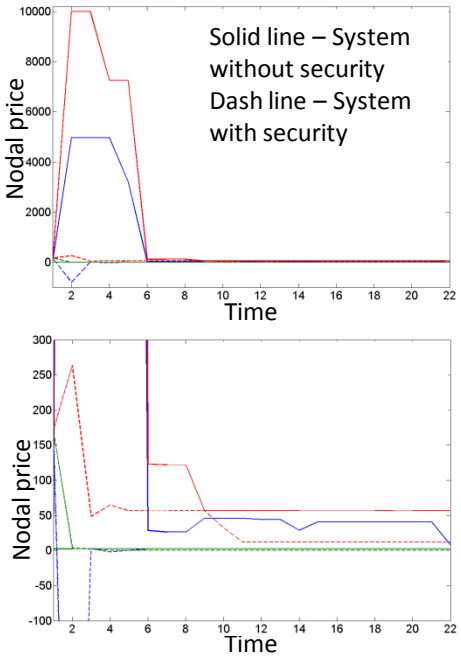
Prepare system for possible contingencies

↓

Optimal generation dispatch

↓

***Minimum* possible dispatch cost (DC) and electricity price**



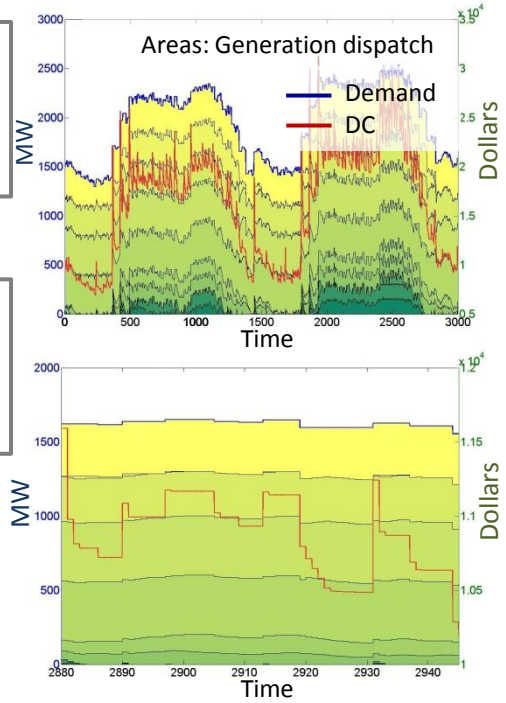
Nodal prices of bus 15 for three possible contingencies

- The Real Time Balancing Market

Find *optimal* generation schedule every minute

↓

***Minimum* possible dispatch cost (DC) and electricity price**



Generation dispatch of 15 G for 3000 minutes

This master project develops a short-run economic dispatch for *handling* both *low* and *high frequency contingencies* in the power system, *respecting* its *physical limits*. The proposed model is a *LP problem* and therefore *Nodal prices* are obtained. This approach allows to *decrease dispatch cost* of the system and consequently *electricity price*.