TSO perspective on short-term operations

Impact of renewables for German and European System

IEA – Paris, 15 January 2015
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- TenneT and TSC
- Renewables Growth and other developments in Germany
- Consequences for the system
- Measures to keep the system working
- Renewables and new challenges: an example
TenneT Overview

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TSC: A powerful initiative

- TSO Security Cooperation launched in 12/2008
- Fostering regional European coordination for security of supply, system security, and operational planning
- 13 TSOs covering 10 European countries
- Following a decentralised approach, with TSOs in charge of grid security and remedial actions
- Harmonised capacity calculation mechanisms and remedial actions, new cooperation tools for control centres
- Panels and work groups share knowledge and expertise
- TSCNET Services GmbH in Munich, Germany
- Open to the participation of other TSOs
Developments Germany

- Development wind and solar
- Nuclear Phase-out
- Availability Conventional Power Plants
Growth of solar generation in Germany

2009-2014
Forecasted RES development in Germany

Major part currently not TSO-influencable with market mechanisms

Sources: BMU nach Arbeitsgruppe Neue Energien-Statistik (AGEE-Stat)
Nuclear Power Plant Phase-Out

Stages of the phase-out until 2022

2011:
- Biblis A 1.167 MW
- Neckarwestheim 1 785 MW
- Unterweser 1.345 MW
- Isar 1 878 MW
- Philippsburg 1 890 MW
- Brunsbüttel 771 MW
- Biblis B 1.240 MW
- Krümmel 1.346 MW

2015: Grafenrheinfeld 1.275 MW

2017: Gundremmingen B 1.284 MW

2019: Philipsburg 2 1.392 MW

2021: Brokdorf 1.410 MW
- Gundremmingen C 1.288 MW
- Grohnde 1.360 MW

2022: Isar 2 1.400 MW
- Neckarwestheim 2 1.310 MW
- Emsland 1.329 MW

-20.470 MW NPP net generation capacity mainly in the South
Merit-Order-effect due to renewables

Demand

Offer

MW

90,000

35,000

30,000

15,000

-150 €/MWh

40 €/MWh

30,000

90,000
## Closed/mothballed Power Plants

### April 2013 – June 2014

<table>
<thead>
<tr>
<th></th>
<th>Germany</th>
<th>The Netherlands</th>
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<tbody>
<tr>
<td><strong>Gas</strong></td>
<td>3223</td>
<td>5567</td>
</tr>
<tr>
<td><strong>Coal</strong></td>
<td>992</td>
<td>240</td>
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<tr>
<td><strong>Oil</strong></td>
<td>424</td>
<td>-</td>
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<td><strong>Multi fuels</strong></td>
<td>152</td>
<td>-</td>
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<tr>
<td><strong>Lignite</strong></td>
<td>60</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>4851</td>
<td>5807 *</td>
</tr>
</tbody>
</table>

*3284 MW in ‘mottenballen’*
Consequences for the system

- Adequacy
- Flows: volatility, transit flows, etc.
- Voltage stability
- Inertia
Challanges for the secure operation of the German transmission system

- **Ensuring safe transport conditions** facing high loading of North-South- and East-West-Transmission lines, especially in periods of high wind feed-in (North-South imbalance due to location of wind feed-in increased by NPP phase-out)

- **Ensuring safe voltage levels** facing the loss of NPPs as substantial generators of reactive power:
  - Problem of *low* voltages *during winter* (high load conditions)
  - Problem of *high* voltages *during summer* (low load conditions)

- **Ensuring system balance**

Forecast deviations due to:
- RES infeed
- Load development
- Grid losses
- power plant schedules
# Development of (n-1) violations

<table>
<thead>
<tr>
<th>Year</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
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<th>2010</th>
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<th>2012</th>
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<tr>
<td>situations*</td>
<td>2</td>
<td>15</td>
<td>51</td>
<td>172</td>
<td>387</td>
<td>228</td>
<td>312</td>
<td>290</td>
<td>998</td>
<td>970</td>
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<tr>
<td>days</td>
<td>2</td>
<td>14</td>
<td>51</td>
<td>105</td>
<td>185</td>
<td>144</td>
<td>156</td>
<td>161</td>
<td>308</td>
<td>344</td>
</tr>
</tbody>
</table>

* Situations in which measures of § 13 EnWG and § 11 EEG were activated; voltage violations are not counted

**Transport task of grid increases due to Energiewende**
Example: PV-forecast deviation due to snow

Installed PV capacity: 31,900 MW

Deviations up to 3000 MW
Another example of deviation

Morning fog doesn’t disappear
Challenge of compensating low RES generation
Measures to keep the system working

✓ (Network development incl. strategic fit)
✓ (Reserve Power Plants)
✓ (Compensation devices/ Ancillary Services with RES)
✓ (Smart Grids/DSM)
✓ (Market Design)
✓ Harmonization and Coordination
Future TSO coordination through a mandatory framework

TSOs have decided:

- to establish a mandatory framework through which, certain coordination functions will be organized by RSCIs (existing or new);
- All TSOs will be procuring the relevant services in the framework of these RSCIs.

- The contractual instrument for the establishment of the framework for TSO coordination.
- A contract between TSOs of an RSCI that cover the operational cooperation between these TSOs.
A basic services set for coordination through RSCIs will ensure consistency and geographical coverage.

- Improved IGM/CGM Delivery
- Coordinated Capacity Calculation*
- Short and Medium Term Adequacy
- Coordinated Security Analysis
- Outage Planning Coordination

Coordination functions
Commercial versus physical flows

Physical flows impact on NL-BE border after different commercial exchanges of 100MW

- NL → DE
- DE → FR
- CH → FR
RSCI-Regional Security Coordination Initiative

International Coordination

• Data Collection
• Common Grid Model
• Exchange updated files

• Managing impact Remedial Actions influencing a number of countries
• Priority for non costly measures
TSCNET Services GmbH: Our services at a glance

- An international team of experienced experts at TSCNET Services delivers comprehensive services for TSOs and 24/7 support.
  - Made-to-measure coordination services for operational planning, forecast data merging, congestion assessment, and capacity calculation for control centres.
  - High-end IT infrastructure for operational planning.
  - Online information system (real-time awareness and alarming system).
  - High-secure video conferencing system between control centres.
  - Weekly and daily operational planning teleconference (WOPT and DOPT).
  - Daily day-ahead congestion forecast (DACF).
  - Hourly intraday congestion forecast (IDCF).
  - Daily real-time snapshot (RTSN).
  - Moderation of multilateral remedial actions (MRA).
  - Weekly DACF, IDCF, and RTSN report.
  - Additional services in preparation, especially capacity calculation services.
New Challenges

An example
Solar Eclipse
Solar eclipse

20 March 2015

- At maximum 81% coverage of the sun (10:37)
- CWE-region: a dip of 40 GW in 2.5 hour
Thank you for your attention!
TenneT is Europe's first cross-border grid operator for electricity. With approximately 21,000 kilometres of (extra) high-voltage lines and 36 million end users in the Netherlands and Germany, we rank among the top five grid operators in Europe. Our focus is to develop a North-west European energy market and to integrate renewable energy.

Taking power further.

www.tennet.eu