JRC activities and capabilities in the area of security of gas supply

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23/06/2016
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- Support to implementation of Reg. 994/2010
- Support to the LNG and gas storage strategy
- Support to the Stress Tests
- Support to implementation of Reg. 347/2013 (Projects of Common Interest)
- Conclusions
**EUGas model**

- EU model (hydraulic, facility level)
- Extension to Ukraine, Turkey & Balkans

**Key applications**

- Projects of Common Interest
- Risk Assessment of EU regions
- Gas quality issues

**Challenges**

- Reliable data (layout, capacities, demand per node etc.)
  - Non-Disclosure Agreements
**GEMFLOW model**

- **EU model (mass-balance; one MS – one node) for supply emergencies**
- **Extension to Ukraine, Turkey & Balkans**

**Key applications**

- **Stress tests**
- **EU-wide crises analysis**

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**EU26 + 4 Countries to be balanced**

- 9 Importer Countries

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**Monte Carlo capabilities**
JRC capabilities

ProGasNet tool

Capabilities
- Probabilistic models, graph theory
- Vulnerability/resilience analysis
- Critical nodes
- Bottleneck identification
- Monte Carlo capabilities

Challenges
Reliability/vulnerability data
Energy trade model

- EU & Global model
- Focus on LNG
- Focus: actors, transactions

Key applications
- Gas markets
- Security of supply
- Crisis scenarios

Challenges
- More detailed data
- Confidentiality of long-term contracts
Support to Reg. 994/2010

Regional Risk Assessment for the South-East region (EL-BG-RO)

Infrastructure standard (N-1)

<table>
<thead>
<tr>
<th></th>
<th>RO+BG+EL</th>
<th>RO+BG+EL (discounting the transit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Largest gas infrastructure = EP2</td>
<td>Isaccea Entry Point</td>
<td>Isaccea Entry Point</td>
</tr>
<tr>
<td>Entry Points (EPm)</td>
<td>115.1 mcm/d</td>
<td>115.1 mcm/d</td>
</tr>
<tr>
<td>Production (Pm)</td>
<td>32.2 mcm/d</td>
<td>32.2 mcm/d</td>
</tr>
<tr>
<td>Storage (Sm)</td>
<td>31.3 mcm/d</td>
<td>31.3 mcm/d</td>
</tr>
<tr>
<td>LNG capacity (LNGm)</td>
<td>12.5 mcm/d</td>
<td>12.5 mcm/d</td>
</tr>
<tr>
<td>Capacity of largest infrastructure (Im)</td>
<td>95.0 mcm/d</td>
<td>95.0 mcm/d</td>
</tr>
<tr>
<td>Transit gas to neighbours</td>
<td></td>
<td>44.1 mcm/d</td>
</tr>
<tr>
<td>Gas demand 1-in-20 (Dmax)</td>
<td>100.9 mcm/d</td>
<td>100.9 mcm/d</td>
</tr>
<tr>
<td>Demand-side capacity (Deff)</td>
<td>12.64 mcm/d</td>
<td>12.64 mcm/d</td>
</tr>
<tr>
<td>N-1 formula (%) with Deff*</td>
<td>108.9%</td>
<td>58.6%</td>
</tr>
<tr>
<td>N-1 formula (%)</td>
<td>95.2%</td>
<td>51.3%</td>
</tr>
</tbody>
</table>

Supply Trace:
- >90%
- 60-90%
- 40-60%
- <40%
- Not applicable
Support to Reg. 994/2010

Regional Risk
Assessment for the South-East region (EL-BG-RO)

<table>
<thead>
<tr>
<th>Country</th>
<th>Gas Demand, mcm/d</th>
<th>Gas Deficit, mcm/d</th>
<th>Peak demand situation (BCS)</th>
<th>Gas Sources, mcm/d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Isaccea</td>
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<td></td>
<td></td>
<td>Kipi</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Chiren UGS, send out at 52 bar</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>LNG Revithousa</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>16.8</td>
<td>-12.5</td>
<td>68.9</td>
<td>2.3</td>
</tr>
<tr>
<td>Greece</td>
<td>19.4</td>
<td>-7.9</td>
<td>Scenario 1.a</td>
<td>X</td>
</tr>
<tr>
<td>BG Transit</td>
<td>43.2</td>
<td>-43.2</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Complementary Cumulative Distribution Function of Unserved Gas

Diagram showing pipeline and storage locations with flow rates.
Use of hydraulic models to assess 'security of supply'

Example of Baltic states & Finland

- **Balticconnector Interconnector EE-FI**
  - 7.2 Mcm/d reverse flow
  - 2 GS 10 MW each
  - Design and permitting (2020)

- **Paldiski LNG**
  - Stage I: 3.84 Mcm/d; 160,000 cm tank
  - Stage II: 14 Mcm/d; 320,000 cm tank
  - Commissioning 2020

- **Enhancement of LV-LT Interconnection**
  - Parallel pipeline 40 km
  - 12 Mcm/d LT→LV
  - Planned (2021)

- **GIPL Interconnector PL-LT**
  - 2.7 Mcm/d LT→PL
  - 6.6 Mcm/d PL→LT
  - 177 km in LT territory
  - 534 km in total
  - Design and permitting (2019)

- **Hamina Kotka LNG**
  - 0.44 Mcm/d
  - 30,000 cm tank
  - Commissioning 2018

- **Tallin LNG**
  - [Stage I: 3.84 Mcm/d; 160,000 cm tank]
  - Stage II: 11.0 Mcm/d; 320,000 cm tank

- **Enhancement EE-LV**
  - New Compressor Station (35 MW)
  - 10 Mcm/d reverse flow
  - Design and permitting (2019)

- **Expansion UGS Incuikalns**
  - Volume: from 2.3 to 2.8 Bcm
  - Withdrawal Capacity: from 28-30 to 34-35 Mcm/d
  - FID (Stage 1)
  - (Stage 1 & 2: 2022; Stage 3: 2027)
Example of Baltic states & Finland

Scenario Regional N-1

Only exports to Kaliningrad reduced

Note that Incukalns UGS is working at maximum withdrawal capacity

Delivery Pressure at Kaliningrad in this scenario is 28 bar. This might be too low.

FI: 27.8
EE: 8.4
LV: 12.6
LT: 17.0
Exports to RU decreased (-3.0)
Grid Improvements 2009 - 2014

JRC elaboration based on ENTSO-G data

Aggregated cross-border capacity within the EU
- Changes between 2009 and 2014 -

Capacities in Mcm/d are in bold for 2014 and in italic for 2009. Capacity direction is indicated by an arrow. Arrows in bold indicate major improvements.
Gas crisis simulation

Interruption of transit gas from Russia to EU via Ukraine (GEMFLOW, 2009 demand)
Support to LNG and storage strategy

Supply of gas via

- LNG (new terminals)
- Projects of Common Interest
- Cooperation
LNG & storage strategy

Impact of closing storage facilities

Reference Case – storages as of today
LNG & storage strategy

Case Storage 1 – closing smallest facilities

Simulation
- Considered
- Not considered

Impact of closing storage facilities
Case Storage 2 – closing facilities not covering operational costs
## LNG & storage strategy

### Study on the impact of closing some storage facilities

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Storage Case</th>
<th>Level</th>
<th>Duration</th>
<th>EU Expected Percentage of Unserved Gas CONS 2015</th>
<th>EU Expected Percentage of Unserved Gas CONS 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>Reference</td>
<td>60%</td>
<td>30 days</td>
<td>1.71%</td>
<td>2.26%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>90 days</td>
<td>2.31%</td>
<td>9.96%</td>
</tr>
<tr>
<td>RU</td>
<td>Case 1</td>
<td>60%</td>
<td>30 days</td>
<td>1.72%</td>
<td>5.24%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>90 days</td>
<td>2.37%</td>
<td>12.15%</td>
</tr>
<tr>
<td></td>
<td>Case 2</td>
<td>60%</td>
<td>30 days</td>
<td>1.71%</td>
<td>2.37%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>90 days</td>
<td>2.31%</td>
<td>11.05%</td>
</tr>
</tbody>
</table>
Study the impact of different interruptions of Russian gas to the EU

Results of a gas winter crisis (6-month total gas Flow interruption)

Solidarity measures considered

Different effect depending on the region
Role played by JRC in the 2\textsuperscript{nd} lists of Projects of Common Interest

- Development of a \textit{methodology} based on Principal Component Analysis (PCA) to combine groups of indicators per dimension (security of supply, competition, market integration, sustainability)

- Application of the methodology to the \textit{indicators} generated by ENTSO-G

- Derivation of \textit{lessons learnt} and proposal to improve the methodology, heading to the 3\textsuperscript{rd} list
Concluding remarks

• Crucial policies of the **Energy Union** (Security of gas supply, PCIs, market) can benefit from dedicated S&T tools

• Need for **collaboration and trust** for the sharing of data

• **JRC** is playing a **central role** in support of policies
  • Information honest broker
  • Simulation models
  • Assessment methods
Thanks for your attention!

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