Winter Outlook 2017-2018

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Foreword

TIGF and GRTgaz jointly release Winter Outlook 2017-2018 in order to share with the market their projections for next winter and inform French gas market players of the strain situations that may arise on their networks and the specific measures they are taking for the forthcoming winter. In March 2017, GRTgaz and TIGF realised that underground storage capacity reservations for winter 2017-2018 were very low, and therefore published a first release of this Winter Outlook in May 2017. This new release clarifies the vision for this winter by incorporating an update of the subscribed capacities, especially on storages.

The French TSOs GRTgaz and TIGF must ensure safety, efficiency and balancing on their respective network at all times\(^1\). In accordance with obligations incumbent on natural gas transmission operators, the GRTgaz and TIGF networks have the required capacity to ensure continuity of transmission, including during peak periods\(^2\).

The design of the French networks is based on diversified entry points (interconnections, LNG terminals and underground storage facilities), offering to their users a choice between various combinations of supply.

However, the proper operation of gas system in winter relies on an optimized and diversified management of these supplies.

\(^1\) French Energy Code, L431-3

\(^2\) "P2", i.e. an extremely low temperature over three consecutive days, likely to occur statistically once every 50 years (in article R121-8 of the French Energy Code).
Summary

GRTgaz and TIGF confirm that underground storage capacity subscriptions by shippers for winter 2017-2018 (all points taken together) are insufficient to secure supply to French consumers in the event of a peak cold period and to honour export capacity subscriptions to Belgium, Switzerland and Spain. In particular, there is a very high probability of sustained use of output capacities to Switzerland at Oltingue, following the capacity reductions announced at Wallbach in the German-Swiss direction for this winter.

An in-depth study of high consumption scenarios over several cold days or over a 1 in 50 year cold winter also shows that the low volume of storage capacity reserved would require record high levels of supply from border points and supplies of LNG in volumes never seen before.

Lastly, in the event of 10-day cold spell not anticipated by the market, if storage subscriptions remain at this level, the balance coverage won’t be possible unless quick deliveries of LNG.

This scenario confirms the need to dispose of adequate volumes of stored gas, particularly in the TRS zone, at the start of and throughout the winter, in order to ensure balance coverage during cold periods.

As regards bottlenecks, the South-East bottleneck is deemed highly likely in the event of limited LNG supplies, particularly during cold periods. This may be aggravated by low subscription at the South-East PITS.

The North bottleneck may also occur if low storage subscription is offset by high supply levels from the North border points.

GRTgaz and TIGF emphasize shippers' responsibility in balancing their portfolio and of the suppliers in supplying their customers throughout the winter, at peak times and consistently, in the event of a cold winter.
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Balance coverage at "P2" peak cold levels – Winter 2017-2018 - France H+B
Reasoning based on available capacities

Calculation assumptions:
Gas demand during a 1 in 50 year Cold Peak
PIR Entries and PITTMs: *Obergailbach: firm exit capacities sold on German side
PIR Exits: *Pirineos: firm capacities subscribed, considered on exit
PITS: Peak withdrawal subscriptions recorded as at 05/10/2017 including performance gas and excluding additional security stock.

3 "P2", i.e. an extremely low temperature over three consecutive days, likely to occur statistically once every 50 years (as in article R121-8 of the French Energy Code).
Additional storage subscriptions during summer (+124 GWh/d compared to the initial version of Winter-Outlook) provides a slightly surplus of available capacities for the 1 in 50 cold peak for winter 2017-2018. However, the surplus remains low and requires the full usage of firm entry capacities proposed to PIRs and PITTMs, in order to cover the French gas balance at Peak.

This exercise constitutes a theoretical approach that does not predict real use of network entry and exit points, and in particular LNG supplies. Indeed, the PIR and PITTM facilities have never yet made maximum usage of all firm capacity at most points, and never simultaneously.

Bear in mind that this balance appeared in significant surplus in the Winter Outlook exercises presented in previous years. This difference is primarily explained by a sharp fall in storage subscriptions for next year (down 337 GWh/d compared to last winter). The exit points at Pirineos (+146 GWh/d at exit) and Alveringem (+100 GWh/d at exit) and of the Dunkirk LNG terminal (+100 GWh/d at entry) have also been taken into account differently to better take into consideration existing contractual commitments.

Reasoning based on firm capacity subscriptions

The reasoning based on firm capacity subscriptions provides additional insight. It gives an indication of the likely usage of the network by considering that capacity subscriptions reflect shippers’ intentions in terms of supply with optimal use of the capacities they have subscribed. This reasoning makes it possible to identify the additional subscriptions that will be necessary to secure supply in the event of a Cold Peak.

This exercise considers firm capacity subscriptions at PIRs (entry and exit) and PITTMs for January 2018 and recorded as at 05/10/2017, and storage capacity subscriptions as at 05/10/2017 for next winter.

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4 Storage subscriptions recorded as at 05/10/2017 including performance gas: this assumption is misleading as the Winter Outlooks for previous years considered underground storage subscriptions at the end of October; however, there are currently no signs to suggest a more favourable assumption regarding underground storage reservations for next winter.
**Calculation assumptions:**
- Gas demand during a 1 in 50 year Cold Peak
- PIR Entries and PITTMs: Firm capacity subscriptions for January 2018
- PIR Exits: *Pirineos: firm capacities subscribed, considered on exit
- PITS: Peak withdrawal subscriptions recorded as at 05/10/2017 including performance gas and excluding additional security stock.

Based on full usage of capacity subscriptions, which assumes that the LNG terminals would dispose of enough stored gas to satisfy such output on the day of the Cold Peak as well as the cold days leading up to and following it, this approach reveals a deficit in the order of almost 209 GWh/d for a 1 in 50 year Cold Peak (deficit reduction of 131 GWh/d since the previous version of Winter Outlook 2017-2018 due to additional subscriptions to PITS and PIR). Unless storage capacity subscriptions are increased, this quantity of gas will have to come from remaining entry capacities available at the PIRs and PITTMs, and/or will require a significant reduction by shippers of exits to neighbouring countries.
BALANCE COVERAGE FOR A COLD PERIOD

Reasoning based on 10 days of cold weather

The reasoning based on 10 consecutive days constitutes a new approach that aims to examine security of supply in the event of simultaneous, non-extreme contingencies representing conditions close to those encountered in recent winters.

This reasoning involves three stages:

1. Quantification of supply needs from PITTM and PITST during a sustained, 10-day cold period encountered in the past (e.g. in February 2012), taking into account entries and exits from PIRs at the highest historical level per zone;
2. Quantification of LNG needs for the period, taking into account underground storage subscriptions as at 05/10/2017;
3. Quantification of the LNG supply need (additional volume) for the period, taking into account volumes of stored LNG recorded in the past in the LNG terminals.

The graphs below show the supply needs resulting from the three stages described above for the France, North and TRS zones, with usage of the North-South link in the order of 270 GWh/d. The calculation is presented in detail in Appendix 4.

In order to guarantee nationwide supply during this 10-day period taking into account optimal use of PIR entries, total gas needs from PITTM and PITST facilities total around 21.3 TWh, of which 9.4 TWh in the North zone and 11.9 TWh in the TRS zone.
If we consider that stored gas is withdrawn to the maximum of its capacity subscriptions\(^5\) over 10 days (an assumption largely dependent on the initial level of stock actually present at the start of the cold period), at least 2.4 TWh of output must be obtained from the PTTMs.

With average storage levels of 3 TWh in winter in the LNG terminals, the 10-day scenario shows that it will be necessary to plan for additional supplies of LNG in the order of 2.4 TWh (including 1.5 TWh in the North and 0.9 TWh in the South) to ensure coverage of the gas balance for France. In the event of an LNG deficit, the supply deficit could therefore total 2.4 TWh for France.

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\(^5\) Peak withdrawal capacity based on underground storage subscriptions as at 05/10/2017
Regarding the South-East part of the GRTgaz network, the chart below shows that capacity subscriptions to the South-East PITS allow to cover the supply needs downstream of the South-East bottleneck for a 10-day cold period.

However, even for LNG arrivals at Fos-sur-Mer at 70 GWh/d, 35% of the subscribed stocks could be used in 10 days.

LNG emissions from Fos-sur-Mer LNG terminals are therefore expected in order to ensure a sufficient volume and capacity at PITS Sud-Est to cover several cold spells, situations that have been encountered in the past.
Reasoning based on a cold winter

A reasoning based on an entire cold winter\(^6\) (from November to March) makes it possible to assess the minimum supply needs of PITTM and PITS facilities in the event of maximum use\(^7\) of the PIRs in terms of entry and exit.

The graph below shows the supply needs at PITTM and PITS facilities for France. The calculation is presented in detail in Appendix 5. The results are presented in terms of volumes necessary for the entire winter.

In the event of a cold winter, taking into account sustained use of PIRs at entry, needs from the PITTM and PITS facilities total around 168 TWh throughout the winter.

Assuming full use of the storage volumes subscribed as at 05/10/2017 for winter 2017-18, it would be necessary to plan for 70 TWh of supply to PITTM facilities in the event of a cold winter. These PITTM supply needs are far higher than what we have observed on average in the past (i.e. 40 TWh), resulting in an additional need of 30 TWh for the winter. Only the sustained use of the PITTM over the entire winter at over 70 TWh would cover the balance for France during a cold winter.

The reasoning by zone gives the same conclusion, with the spread of deficits between zones depending on usage of the North-South link.

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\(^6\) “P2”, i.e. an extremely low temperature over three consecutive days, likely to occur statistically once every 50 years (as in article R121-8 of the French Energy Code).

\(^7\) Maximum value based on historical data. Details in Appendix 5.
CONCLUSIONS REGARDING BALANCE COVERAGE AND NETWORK BALANCING

Although infrastructure operators propose the necessary capacity to supply customers during cold peaks and cold periods, the weak storage subscriptions will require new subscriptions on PIR, and PITT or a drastic reduction of exists to cover cold peaks.

Furthermore, the scenarios for coverage of a cold episode show that despite the assumptions maximising entries at border points, the level of storage subscriptions suggest heavy additional supply needs which would appear to be difficult to cover by additional LNG supplies.

The 10-day cold period scenario, combined with a temporary interruption of LNG deliveries, similar to the situation encountered in recent years, appears to be particularly critical as it highlights a 2.4 TWh deficit over 10 days, i.e. an equivalent of 240 GWh/d. Therefore, the balance coverage won’t be possible unless quick deliveries of LNG.

With the storage subscriptions currently recorded, in the case of an entire cold winter, a significant increase in LNG arrivals with be necessary to ensure the balance coverage all over the winter. An average winter may also give rise to deficit situations with average LNG supplies.

For this reason, the TSOs request that suppliers secure the necessary volumes of gas to cover their customers' consumption during cold peaks in winter, for a sustained period and in the event of a cold winter.

This scenario building confirms the need to dispose of adequate volumes of stored gas, particularly in the TRS zone, at the start of and throughout the winter, in order to ensure balance coverage during cold periods.

Furthermore, GRTgaz and TIGF would like to draw shippers' attention to their obligation to secure their needs on an individual basis, and urge them to do so as soon as possible on any given gas day.

They would also like to remind shippers that in order to manage bottlenecks, TSOs require information as soon as possible regarding shippers' intentions, i.e. as early as the previous gas day.
MANAGEMENT OF STRAIN SITUATIONS

Vigilance mechanism

The vigilance mechanism provides the market with short-term indications (6 days in advance) regarding strain situations on the network.

In order to alert the market and allow it to anticipate any strain situations, GRTgaz reactivates its vigilance mechanism by providing daily information on SMART GRTgaz website (http://smart.grtgaz.com/) and by email sent to shippers. The mechanism will be in operation from 6 November 2017 to 31 March 2018.

The following strain situations will be studied for Winter 2017-2018:

- Insufficient balance coverage
- North Bottleneck
- South-East Bottleneck

The vigilance mechanism provides insight for the given day and the 5 following days. A vigilance indicator is published daily. It is composed of 3 levels with recommendations according to the type of strain situation. All 3 levels are identified by GRTgaz National Dispatching on a daily basis:

- Green: no strain identified
- Orange: orange alert in progress / likely network strain
- Red: red alert in progress / network strain observed or highly likely

In case of actual bottleneck, GRTgaz will display each day before 9 a.m the additional supply needs downstream of the bottleneck to source via the localised spread mechanism. Such information regarding the South-East bottleneck will be posted by TIGF via its website.

Additional information disclosed to the market

During long periods of strain, GRTgaz may publish additional information on its grtgaz.com website in order to quantify local or global supply needs and ensure balance coverage or manage bottlenecks.
Reminder on bottlenecks

In winter, GRTgaz daily set the overall capacity of the North-South link and the capacity taken off from the South-Atlantic PITS. This capacity corresponds to the maximum capacity that can be transmitted on a given day by GRTgaz network from the North zone and from the South-Atlantic PITS towards the South zone. It is then distributed between the North-South link and South Atlantic withdrawal capacity according to the rules defined in the Operational Network Code (CORE)\(^8\).

The saturation of pipelines is based on several parameters, including the expected consumption and the provisional supply plan based upon the first day-ahead nominations at 2:00 PM. In normal network operating conditions, this overall capacity is higher than the sum of the firm capacities of the North-South link and of the capacity taken-off from the South-Atlantic PITS\(^9\).

Bottleneck appears when the maximum capacity said above is insufficient to meet the supply needs of the market: excess supply upstream of the bottleneck and supply deficit downstream of the bottleneck.

Risks of bottlenecks during winter 2017-2018

The balance coverage for 1 in 50 Cold Peaks, 10-day intense cold periods or over the entire winter does not reveal any local problems in terms of capacity. The occurrence of bottlenecks will depend on the actual usage of storage and LNG arrivals.

Feedback from previous winters and in particular the winter of 2016-2017 shows that the South-East bottleneck is highly likely when the supply of LNG at the Fos PITTMs is low. In case of repeated episodes, managing South-East bottleneck may also be complicated by the low subscription volume of the South-East PITS for next winter.

The North bottleneck risk also exists. This will depend on the respective use of the PIR and PITTMs facilities. Low storage subscriptions may be offset by high supplies to the North PIRs, thereby increasing the risk of the North bottleneck.

\(^8\) http://www.grtgaz.com/acces-direct/clients/fournisseur-trader/code-operationnel-de-reseau.html

\(^9\) For the South-Atlantic PITS, this is firm capacity related to total consumption, as defined in the Operational Network Code (CORE). Total consumption-related firm capacity varies according to consumption rates.
**South-East Bottleneck**

This bottleneck appears when weak output from the Fos-sur-Mer LNG terminals, low withdrawal from the South-East PITS, and high deliveries towards TIGF via the Cruzy interconnection point all happen.

South-East bottlenecks appears in several areas, either on the Rhône pipeline, or at the Etrez compression site, or on the Centre-Est and Berry pipelines providing West to East transit in the South zone.

**GRTgaz Vigilance Mechanism Recommendations:**

To ease this bottleneck, it is necessary to increase either output from the Fos-sur-Mer terminals or withdrawals from the South-East.

*The graph here on the left shows the situations of South-East bottleneck, with the consumption of the South zone on the X-axis and the supply downstream of the bottleneck on the Y-axis. This data is given for information purposes only. The red zone shows proven bottleneck situations. The orange zone corresponds to the situations where there is a bottleneck risk. The green zone is free of bottleneck.*
North Bottleneck

This bottleneck appears when high supply in the North leads to saturate transit within the North zone of GRTgaz network towards the South zone.

The first bottleneck is located upstream of the Paris region and appears with high supply at Taisnières H and Obergailbach, and low deliveries at Oltingue simultaneously. The second scenario is located more West, with transit saturation through Paris region with heavy supply in Dunkirk, Taisnières H and Obergailbach, and Dunkirk PITTM, combined with low deliveries at Oltingue and low withdrawal from the North-Atlantic and North-West PITS.

GRTgaz Vigilance Mechanism Recommendations:

To deal with this bottleneck, supply must be reduced from the North (Dunkirk, Taisnières H, Obergailbach and Dunkirk PITTM), and withdrawals increased from storage facilities located downstream of this North bottleneck (North-West and North-Atlantic PITS), along with additional output from the Montoir-de-Bretagne LNG terminal or a reduced use of the North-South link with higher supply in the South zone.

The graph here on the left shows the situations of North bottleneck, with the consumption of the North zone on the X-axis and supply upstream of the bottleneck on the Y-axis. This data is given for information purposes only. The red zone shows proven bottleneck situations. The orange zone corresponds to the situations where there is a bottleneck risk. The green zone is free of bottleneck.
Solutions and mechanisms for managing bottlenecks

GRTgaz will do everything it can to maximise flows at the level of the bottleneck by using its network to maximum capacity. When programming the next gas day the day before, operational solutions to distort physical flows and ease bottlenecks will be systematically studied with the other infrastructure operators.

- For the North Bottleneck: SWAP requests\(^{10}\) to operators of adjacent networks.
- For the South-East bottleneck: Distortion of physical flows at Cruzy in agreement with TIGF on two levels:
  1. Distortion of physical flows at Cruzy until cancellation.
  2. Implementation of reverse flow at Cruzy under certain conditions\(^{11}\).

On the day itself, in the event of a proven strain situation despite the operational measures described above and not eased by the implementation of published recommendations, GRTgaz will take further measures:

1. **Use of the Localised Spread**

   This market mechanism was proposed for winter 2016-2017 following feedback from winter 2016-2017, and makes it possible to identify additional gas needs downstream of bottlenecks while selling the same quantity upstream of the bottleneck. This mechanism is suitable for management of the North and South-East bottlenecks. Details on this mechanism are provided in Appendix 3.

2. **Additional security stock**

   This additional measure set up at the request of the public authorities is dedicated to the management of the South-East bottlenecks for winter 2017-2018. It results in the creation of a 1 TWh security stock in addition to the shippers stock in PITS Sud-Est. GRTgaz will use the additional security stock when the localized spread mechanism does not cover all the downstream needs of the South-East bottleneck. The additional security stock may also be used on a transitional basis at the beginning of the gas day, pending the effect of the localized spread on supplies downstream of the South-East bottleneck.

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\(^{10}\)Neutral balance distortion of contractual flows between network operators. Mechanism not guaranteed.

\(^{11}\)GRTgaz will decide its implementation according to network conditions in order to maintain a sufficient line pack to guarantee consumers demand.
This measure is mentioned by the Energy Regulatory Commission in his public consultation launched during summer for the creation of the single gas market area in France on 1 November 2018.

3. **Operational Instruction Notice (AIO)**

If the requirements making it possible to ease the bottleneck are not sourced in full by the Localised Spread mechanism and the additional security stock, GRTgaz will publish an Operational Instruction Notice\(^\text{12}\), as a result of which GRTgaz may impose on shippers a minimal entry level to the network at points downstream of the South-East bottleneck and a maximum entry level to points upstream of the North bottleneck.

4. **Gas Emergency Plan**

In the event of a persistent bottleneck despite the foregoing measures, resulting in a localised gas deficit downstream of the bottleneck, or an overall gas deficit, GRTgaz and TIGF will alert the French Ministry in charge of energy, which may activate the PUG (french gas emergency plan, see Appendix 2). The TSOs will then implement the appropriate measures laid down in the plan and for which they are responsible.

In a bottleneck situation and until the additional measures become effective, GRTgaz will do everything in its power to ensure continuity of supply for consumers, by using its line pack to the full, requesting assistance from adjacent operators or using its safety stock.

\(^{12}\) Avis d’Instruction Opérationnelle, or ‘AIO’ : Pursuant to the transmission contract
APPENDIX 1: Feedback on winter 2016-2017

In the Winter Outlook 2016-2017, GRTgaz and TIGF emphasized that the appearance of the South-East bottleneck was highly dependent on withdrawals from the South-East PITS and outputs from the Fos-sur-Mer methane plants, and that in previous winters supply plans had led GRTgaz to issue orange and red alerts on numerous occasions.

In winter 2016-2017, South-East bottlenecks were more frequent, leading GRTgaz to communicate specifically on the subject and implement specific measures, including the use of Operational Instruction Notices. This feedback was presented by GRTgaz at the Concertation Gaz meeting on 30 March 2017.

Chronology of winter 2016-2017

End-November 2016

⇒ Publication on 22 November by GRTgaz and TIGF of the first joint Winter Outlook.
⇒ Low LNG supplies at the Fos PITTM (facilities running at minimum technical capacity or stopped from 23 November onwards).
⇒ Significant and early withdrawals from the South-East PITS (Salins) by shippers from 23 November onwards.
⇒ Agreement with TIGF to distort the exit flows to TIGF initially provided for contractually from the GRTgaz network and zero exits at Cruzy to the TIGF network (mechanism maintained on all South-East bottleneck days during the winter).

Mid-December: gradual powering up.

⇒ Delivery hazards concerning LNG arrivals: 3 cargos cancelled in December, representing around 3 TWh.
⇒ Increasing consumption, particular at combined-cycle power plants, due to strain on the electricity network.
⇒ This resulted in 26 days of vigilance regarding the South-East bottleneck between 24 November and 31 December.

13 https://concertationgaz.com/site/home
January: the strain situation reaches a peak.

⇒ Combination of three factors:
  ▪ Lack of LNG: 2.5 TWh received at the Fos PITTM in January out of the 7.4 TWh initially planned by customers.
  ▪ Very low stocks at the South-East PITS for the period.
  ▪ Cold period from 16 to 26 January: total consumption at a maximum of 2,920 GWh/d on the GRTgaz network (including 80 for the South-East natural gas combined cycles).

⇒ 28 days of vigilance regarding the South-East bottleneck requiring, in particular:
  ▪ The use of GRTgaz’s security stock during 11 days, representing 210 GWh in total.
  ▪ Use of Operation Instruction Notices on six occasions, on 12, 13, 20, 21, 22 and 24 January, to shippers with capacity at the South-East PITS at the Fos PITTM, for a total call of 188 GWh.

⇒ Persistent high TRS / PEG spread from 4 to 31 January over €10/MWh, with a peak of over €20/MWh on 24 January.

⇒ Works carried out at Manosque from 3 to 4 January:
  ▪ Works on storage at Manosque rendering the site unavailable, in order to recover the site’s full capacity, essential in the event of a cold period.
  ▪ GRTgaz send shippers active at the PITTM an Operational Instruction Notice in order to ensure minimal take-offs at the Fos PITTM while the works are being carried out.
  ▪ Assistance from TIGF by increasing the pressure of its network upstream of Cruzy (already zero flow) for a possible opening at Cruzy in the direction from TIGF to GRTgaz in the event of a problem with one of the sources in the South-East zone.

⇒ Information for stakeholders: GRTgaz was very quick to issue information on the situation:
  ▪ Market information on 30 December: information on the homepage of the grtgaz.com website in addition to a specific banner on Smart GRTgaz with a link to information and publication of a "REMIT" message.
  ▪ From 6 January: addition in the vigilance mechanism published on SmartGRTgaz of the minimum requirement at the South-East PITS according to withdrawals at the Fos PITTM for the day in progress, and publication of GRTgaz's recommendations for the rest of the winter (preservation of stocks at the South-East PITS in order to be able to respond to one or more cold spells and information on estimated recommended minimum quantities at Fos.
Press conference by the Chief Executive Officer of GRTgaz on 17 January: alert regarding the worrying situation, reminder of GRTgaz's recommendations and the mechanisms in place.

Regular updates to published information: Smart GRTgaz, grtgaz.com website and REMIT messages.

Information for the public authorities: alert as of mid-December then regular information on the situation and its evolution, as well as on the work being carried out to find solutions.

Information for RTE: alert on 30 December then regular information on the situation and its evolution.

End January - early February: return to calm and the end of strain in the South East.

- The arrival of LNG cargos at the Fos-sur-Mer LNG terminals from the end of January and the mild spell brought and end to the strain situation in the South East:
  - 2 vessels loaded at Montoir-de-Bretagne received on 24 January and 4 February;
  - 2 additional cargos on 11 and 13 February.

End-February

- The large quantities of LNG received at the Fos PITTM and the moderate consumption level definitively removed the risk of a gas shortage in the South East zone for the rest of the winter.

Operational management of flows in the South-East zone

The South-East bottleneck appears when there is a supply deficit downstream of network saturations.

The GRTgaz network was used to maximum capacity to transit as much gas as possible at the level of bottleneck fronts situated in the Rhône valley and north of Lyon. This persistent saturation required exceptional levels of usage of the compression stations to maximise gas transmission. There were no failings in GRTgaz facilities during this entire period.

In addition to the flow distortions agreed with TIGF putting Cruzy at zero, the possibility of setting up reverse flows at Cruzy (delivery from TIGF to GRTgaz) was studied but not implemented.
Key lessons learned from winter 2016-2017

Although GRTgaz informed market players of the situation, the absence of any price signal directly reflecting the bottleneck and the absence of market mechanisms available to GRTgaz to manage this situation led to the lack of any incentive to comply with GRTgaz's recommendations.

As the South-East bottleneck is heavily dependent on LNG deliveries, uncertainty regarding the scheduled arrivals of LNG cargos at the Fos-sur-Mer LNG terminals made it impossible to obtain any visibility as to the evolution of the situation, which remained uncertain until the end of February. Potential solutions were studied with the authorities and with the market, including in particular the direct purchase of LNG by GRTgaz and the purchase by GRTgaz of a flow commitment at the Fos PITTM. These solutions were not implemented due to their cost, the potential deadweight effects and the time required for their effective implementation. Studies revealed the complexity and significant amount of time required to bring additional LNG to the South East of France.

Experience from this winter also shows the need to provide more effective explanation of the bottleneck situation and the potentially critical nature of the situation encountered.

Operational Instruction Notices, which were used on a number of occasions to manage the proven South-East bottleneck situations, constitute a contractual tool available to GRTgaz that control the market and function with relatively guaranteed efficiency, in the short term at least. The use of Operational Instruction Notices as a last resort made it possible to avoid customers being cut off.

The interruptibility mechanisms were of no help. In effect, the conditions for activation were not met (AIPC) or were ineffective, as the quantities potentially interruptible remain very low compared to requirements.

As regards the other strain situations, the North bottleneck came close to occurring on certain days, particularly on 19 and 25 January last winter, without resulting in a proven bottleneck situation.
APPENDIX 2: Gas Emergency Plan (PUG)

On 28th November 2013, the French Minister in charge of Energy (Ministre de l'Écologie, du Développement durable et de l'Énergie) issued a decree implementing the Plan d'Urgence Gaz (PUG, the French gas emergency plan, in application of EU Regulation 994/2010 from 20th October 2010 on the security of gas supply).

The French gas emergency plan is designed to be rapidly implemented mechanism to prevent or delay the onset of a supply crisis that could lead to the impossibility to fully meet gas needs in France or in part of the territory.

The national gas emergency plan sets measures by order of priority in the event of a crisis:

1. measures focusing on demand,
2. measures reducing public service obligations,
3. protective measures taken by the French authorities,
4. measures and actions concerning district heating,
5. last resort measures: selective service cut-offs.

A service cut-off survey was undertaken to quantify the potential cut-offs as well as the necessary timeframes.

In case of a major supply crisis or local gas deficit making it impossible to provide natural gas to all customers in the area concerned, natural gas transmission operators and networks will, as a last resort, implement selective service cut-off measures vis-a-vis their customers (except MIG) according to the following principles:

➔ Network operators will alert their respective clients as soon as they incur a major risk of supply interruption;

➔ Network operators will determine the need for selective service cut-offs and potential cut-offs (depending on the results of the survey and the observed levels of consumption);

➔ Network operators will ask their clients to reduce their consumption levels following the priority order defined by the said mechanism.
APPENDIX 3: Description of the localised spread

The Localised Spread is an incentive market mechanism to manage bottlenecks by promoting gas downstream of a bottleneck. It consists in performing two operations simultaneously on the stock market (the TSO purchases the Spread of both operations, i.e. the difference between the purchase price and the sale price):

- a localised purchase from points situated downstream of the bottleneck
- a localised sale from points upstream of the bottleneck.

The Localised Spread constitutes the favoured short-term mechanism as part of the implementation of the TRF. By dealing with the upstream and downstream situations simultaneously, there is no impact on the balancing of either the network or of shippers. Its implementation from winter 2017-2018 enable to test its implementation in advance.

For winter 2017-2018, the TSOs propose to develop this product based on a model very similar to that of the Locational product, using a process known to shippers (shippers eligible for this product will need to update their Locational contract):

- Product can be activated on a "Within Day" (intraday) basis.
- Three call periods, with windows close to but separate from those currently applicable for balancing operations.
- Tender issued by GRTgaz by email, specifying the reason for the tender (bottleneck) and the requirements (volume of gas and the network points upstream and downstream of the congestion concerned).
- Submission of bids by the shippers on the Locational platform, which will be adapted to also respond to the Localised Spread. The stock market transactions therefore use a type of clearing house body in return for financial and physical compensation, for both the contracting parties and for GRTgaz.
- Selection by GRTgaz of Spread bids (which may be explicit or implied).
- Notification by email from the selected shippers to GRTgaz of the quantity and points at which the operations will take place.
- Control of the nominations of shippers whose bids are selected (possible sanctions)
**List of points potentially called for localised spread operations:**

<table>
<thead>
<tr>
<th>Bottleneck</th>
<th>Variant</th>
<th>Downstream (= purchase for GRTgaz)</th>
<th>Upstream (= sale for GRTgaz and TIGF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Bottleneck</td>
<td>North 1</td>
<td>2DK + Montoir (+ North-East*) + North-West + North-Atlantic (+ North-South)</td>
<td>PIV + Obergailbach + Oltingue</td>
</tr>
<tr>
<td></td>
<td>North 2</td>
<td>Montoir + North-East + North-West + North-Atlantic (+ North-South)</td>
<td>2DK + PIV + Obergailbach + Oltingue</td>
</tr>
<tr>
<td>South-East Bottleneck</td>
<td>South-East 1</td>
<td>Fos (+ South-East)*</td>
<td>Jura + South-Atlantic + Lussagnet + Pirineos (+ North-South)</td>
</tr>
<tr>
<td></td>
<td>South-East 2</td>
<td>Fos + South-East + Jura</td>
<td>South-Atlantic + Lussagnet + Pirineos (+ North-South)</td>
</tr>
</tbody>
</table>

*: The South-East PITS and the North-East PITS straddle the South-East 1 and North 1 bottlenecks respectively. These PITS may be positioned upstream and downstream of the bottleneck according to the operational flexibility at each storage facility available on the day and agreed with Storengy.
APPENDIX 4: Details regarding the reasoning based on 10 days of cold weather

Consumption

The level of consumption taken into account is that observed on the gas days of 2 to 11 February 2012, adjusted for the combined-cycle portion in order to obtain a level of electric production from gas equivalent to that encountered during winter 2016-2017.

<table>
<thead>
<tr>
<th></th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 7</th>
<th>Day 8</th>
<th>Day 9</th>
<th>Day 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total France</td>
<td>3 559</td>
<td>3 593</td>
<td>3 356</td>
<td>3 341</td>
<td>3 556</td>
<td>3 754</td>
<td>3 757</td>
<td>3 643</td>
<td>3 596</td>
<td>3 474</td>
</tr>
<tr>
<td>Public distributions</td>
<td>2 685</td>
<td>2 723</td>
<td>2 593</td>
<td>2 578</td>
<td>2 683</td>
<td>2 865</td>
<td>2 876</td>
<td>2 769</td>
<td>2 729</td>
<td>2 702</td>
</tr>
<tr>
<td>Industry excluding combined-cycle plants</td>
<td>619</td>
<td>615</td>
<td>578</td>
<td>577</td>
<td>617</td>
<td>634</td>
<td>626</td>
<td>619</td>
<td>612</td>
<td>587</td>
</tr>
<tr>
<td>Combined-cycle plants</td>
<td>255</td>
<td>255</td>
<td>185</td>
<td>185</td>
<td>255</td>
<td>255</td>
<td>255</td>
<td>255</td>
<td>255</td>
<td>185</td>
</tr>
<tr>
<td>Total North</td>
<td>2 357</td>
<td>2 335</td>
<td>2 164</td>
<td>2 166</td>
<td>2 286</td>
<td>2 432</td>
<td>2 421</td>
<td>2 345</td>
<td>2 316</td>
<td>2 239</td>
</tr>
<tr>
<td>Public distributions</td>
<td>1 749</td>
<td>1 733</td>
<td>1 630</td>
<td>1 628</td>
<td>1 679</td>
<td>1 812</td>
<td>1 809</td>
<td>1 738</td>
<td>1 712</td>
<td>1 697</td>
</tr>
<tr>
<td>Industry excluding combined-cycle plants</td>
<td>437</td>
<td>431</td>
<td>404</td>
<td>408</td>
<td>437</td>
<td>449</td>
<td>441</td>
<td>437</td>
<td>433</td>
<td>412</td>
</tr>
<tr>
<td>Combined-cycle plants</td>
<td>170</td>
<td>170</td>
<td>130</td>
<td>130</td>
<td>170</td>
<td>170</td>
<td>170</td>
<td>170</td>
<td>170</td>
<td>130</td>
</tr>
<tr>
<td>Total TRS</td>
<td>1 202</td>
<td>1 258</td>
<td>1 192</td>
<td>1 175</td>
<td>1 269</td>
<td>1 323</td>
<td>1 336</td>
<td>1 298</td>
<td>1 280</td>
<td>1 235</td>
</tr>
<tr>
<td>Public distributions</td>
<td>936</td>
<td>990</td>
<td>963</td>
<td>950</td>
<td>1 004</td>
<td>1 053</td>
<td>1 067</td>
<td>1 031</td>
<td>1 017</td>
<td>1 005</td>
</tr>
<tr>
<td>Industry excluding combined-cycle plants</td>
<td>181</td>
<td>183</td>
<td>174</td>
<td>170</td>
<td>180</td>
<td>185</td>
<td>184</td>
<td>182</td>
<td>178</td>
<td>175</td>
</tr>
<tr>
<td>Combined-cycle plants</td>
<td>85</td>
<td>85</td>
<td>55</td>
<td>55</td>
<td>85</td>
<td>85</td>
<td>85</td>
<td>85</td>
<td>85</td>
<td>55</td>
</tr>
</tbody>
</table>

Storage capacities

The withdrawal capacities taken into account correspond to the peak capacities based on subscriptions of underground storage as at 05/10/2017 including withdrawal capacities linked to performance gas, i.e. 1,594 GWh/d (same capacity as in the peak balancing exercise). For the entire 10 days, we consider an optimistic hypothesis with constant withdrawal capacity. The withdrawal capacity and our ability to maintain it over time depends on the effective level of stored gas at the start of the period.
Use of PIRs

The quantity taken into account entering the PIRs for each of these 10 days corresponds to the historical maximum observed on at least one day across all PIRs in winter since 2010.

<table>
<thead>
<tr>
<th>Max. historical usage in GWh/d of all points</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIR Entries North</td>
</tr>
<tr>
<td>PIR Exits North</td>
</tr>
<tr>
<td>PIR Exits South</td>
</tr>
</tbody>
</table>

During cold periods, we also observe high levels of 14 exits to Switzerland (to supply Italy) and Spain.

Use of the North-South link

We consider usage of the North-South link at the level of total-consumption related firm capacity, i.e. 270 GWh/d.

LNG supply hazards

If we consider a temporary disruption of normal LNG supplies, the level of available stock in LNG terminals at the start of the 10-day cold period will be entirely used for PITTM output during the period.

A study of historical stock levels in LNG terminals at 6 a.m. in winter since 2012 shows an average starting stock of around 3 TWh (2 TWh in the North and 1 TWh in the South), i.e. around 150,000 m³ of LNG in stock and available for each PITTM15.

Consideration of LNG storage as a means of modulation to fulfill storage obligations (decree of 31 July 2017 on the modalities for taking into account other modulation instruments for the application of the reporting and holding obligation and storage capacity of natural gas suppliers) does not change the assumption on the stock present in the terminals. Indeed, this decree does not guarantee the presence of LNG stock throughout the winter.

14 The Alveringem PIR is taken into account in recent history, but remains unrepresentative.
15 Due to the lack of historical data for the LNG DK PITTM, the average level of stored LNG was transposed based on observations of the other PITTMs.
APPENDIX 5: Details regarding the reasoning based on a cold winter

Consumption

A cold winter corresponds to a winter (November to March, i.e. 151 days), with 1 in 50 year levels of extremely cold weather\(^{16}\). The consumption taken into account is as follows:

<table>
<thead>
<tr>
<th>Cold winter</th>
<th>Total consumption (TWh)</th>
<th>including combined-cycle (TWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North (including zone B)</td>
<td>233</td>
<td>24</td>
</tr>
<tr>
<td>TRS</td>
<td>119</td>
<td>12</td>
</tr>
<tr>
<td>GRTgaz South</td>
<td>94</td>
<td>12</td>
</tr>
<tr>
<td>TIGF</td>
<td>25</td>
<td>0</td>
</tr>
</tbody>
</table>

Storage capacities

We consider that all volumes subscribed as at 05/10/2017, including performance gas operations for winter 2017-2018, are used in this scenario, i.e. 98 TWh. The reasoning based on a cold winter is conducted in volumes. Despite everything, it implies optimal management of the take-off campaign in order to dispose of the necessary withdrawal capacities each day of the cold winter.

Use of PIRs

For this scenario, and in view of storage subscriptions observed as at 05/10/2017, it is appropriate and necessary to apply high PIR supply assumptions. The assumption adopted takes into account supply at all PIRs at both entry and exit at the 95th percentile with regard to historical data in winter since 2010 = 95% of the historical data is below this value and only 5% above.

This PIR entry assumption is a very optimistic, as it assumes that this value exceeded only 5% of the time is repeated every day during the cold winter.

\(^{16}\) “P2”, i.e. an extremely low temperature over three consecutive days, likely to occur statistically once every 50 years (as in article R121-8 of the French Energy Code).
Usage in GWh/d

<table>
<thead>
<tr>
<th></th>
<th>Max. 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIR Entries</td>
<td>1572</td>
</tr>
<tr>
<td>PIR Exits</td>
<td>-359</td>
</tr>
</tbody>
</table>

During cold periods, exits\(^\text{17}\) can also be high towards Switzerland (to supply Italy) and Spain.

**Use of PITTMs**

The median use (50% of historical data below and 50% of historical data above this value) and 95% maximum use (same reasoning as for the PIRs) based on historical data\(^\text{18}\) for winters since 2010 are presented in the table below.

<table>
<thead>
<tr>
<th>Use of PITTMs in GWh/d.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>267</td>
</tr>
<tr>
<td>95% max</td>
<td>557</td>
</tr>
</tbody>
</table>

Consideration of LNG storage as a means of modulation to fulfill storage obligations (decree of 31 July 2017 on the modalities for taking into account other modulation instruments for the application of the reporting and holding obligation and storage capacity of natural gas suppliers) does not change the assumption on the stock present in the terminals. Indeed, this decree does not guarantee the presence of LNG stock throughout the winter.

\(^{17}\) The Alveringem PIR is taken into account in recent history, but remains unrepresentative.

\(^{18}\) The LNG DK PITT is taken into account in recent history, but remains unrepresentative.