Study of French gas transmission networks

Stage report - Phase 1and 2

TIGF GRTgaz

1. Purpose

To conduct a study based on a common French gas network model and appropriate flow scenarios in order to:

- identify major areas of congestion on the French gas transmission network over the short and medium terms,
- evaluate the conditions for implementing CRE guidelines of the 2nd of July 2009 concerning the management of the interface between the GRTgaz South zone and the TIGF zone from the 1st of April 2011,
- propose solutions to remedy the areas of congestion (10-year plan).

The study was conducted in accordance with CRE/DIRGAZ memo dated the 18th of September 2009 (see Annex)

2. Contents

3. Working group

The working group consists of the following members:

- For GRTgaz:
  - Benoit Guerber,
  - Jean Baptiste Joliot,
- For TIGF:
  - Paul Pérona
  - Yves Freyssinier
  - Jean Michel Laborde
- Storage facilities
  - Storengy: Benjamin Bellon
  - TIGF: Eric Bouley
- CRE
  - Emmanuel Bouquillon

- Work began on the 1st of October 2009 in Paris with the drawing up of a work plan.

4. General

4.1. Description of the French network

4.1.1. **General description**

Description of the French gas network

The French network is not independent in terms of resources. It is dependent upon imports:

- Via adjacent networks and, so far, exclusively on the north and east borders,
- Via 3 LNG terminals, Montoir on the Atlantic side and Fos Tonkin and Fos Cavaou on the Mediterranean side.

Exports are:

- To Spain
- To Italy via Switzerland

Figures for the start of 2010:

Consumption in France at 2% risk	4200 GWh/d
Storage facility emission capacity	2800 GWh/d
Adjacent network supply	1950 GWh/d
LNG Terminal supply	760 GWh/d
Export to adjacent networks	400 GWh/d
Production in France (Lacq Plant)	25 GWh/d

Peak arbitrage capacity is of 935 GWh/d.

Zones showing strong levels of consumption:

- The Ile de France area represents 20% of French consumption (800 GWh/d at 2% risk),
- Rhône Alpes region, (430 GWh/d), 10%.

Consumption for the South West (TIGF zone) represents 9% (380 GWh/d) of French consumption.

The centre of France is an extremely weak area of the French gas market (less than 5%), which explains the paucity of infrastructures in this region.

The consumption of L gas in the North represents approximately 425 GWh/d at 2% risk

Storage facilities:

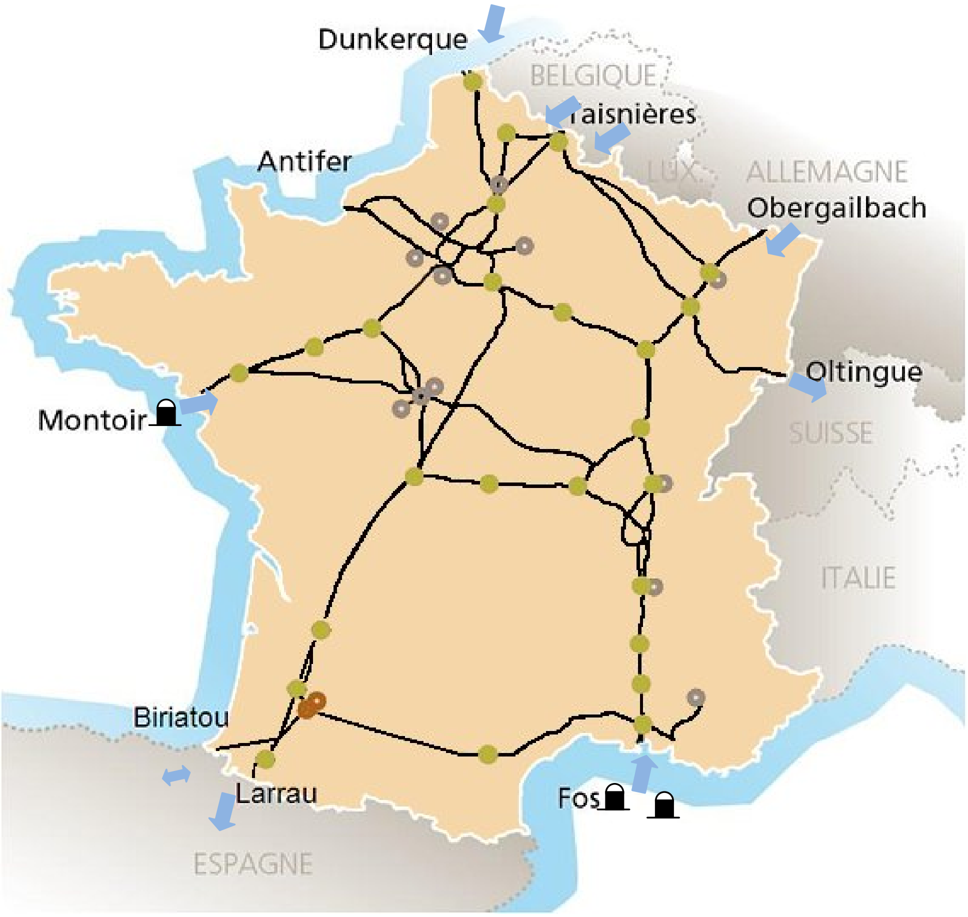
Aquifer storage facilities at Chemery (52 TWh) and Lussagnet (29 TWh), located to the west of the transmission network, represent 56% of potential storage volumes in France (143 TWh). They have a strong withdrawal capacity (1220 GWh/d at 2% risk) over long periods. They are relatively far away from areas of high consumption.

The saline storage facilities are relatively low in volume (11 TWh) associated with a strong withdrawal capacity (750 GWh/d). They are situated in the South West.

Infrastructures:

The French network is structured around 2 principal axes:
West axis: North - Paris - Chemery - Lussagnet - Spain
East axis: Obergailbach – Etrez - Lyon - Fos

These axes are connected by transverse facilities summarized as follows:
- Taisnières - Oltingue,
- Paris region - Burgundy,
- Chemery - Lyon region
- Lussagnet - Fos



The main French gas network infrastructures

4.1.2. **Firm annual capacities sold at interface points in November 2009**

		2009	
		Entry	Exit
GRTgaz North	Dunkirk	570	
	Taisnières H	590	
	Obergailbach	550**	
	Montoir	360	
	Oltingue		223
	GRTgaz South	120	230
GRTgaz South	GRTgaz North	230	120
	Fos	410	
	TIGF	30*	325
TIGF	GRTgaz South	325	30*
	Larrau		100
	Biriatou	5	10

*Capacities to which are added 150 GWh/d of transfer service from Cruzy to Castillon for GRTgaz
** Obergailbach – capacities sold increase to 620 GWh/d from December 2009

4.1.3. **North-South link**

The physical capacity of the North/South link is 450 GWh/d (facility saturation study), but this maximum capacity can only be ensured when the distribution of supply is balanced geographically.
Thus, the firm capacity of the North to South link guaranteed by GRTgaz is 230 GWh/d, and interruptible capacity is 220 GWh/d.

4.1.4. **GRTgaz South - TIGF link**

The GRTgaz South and TIGF zones are linked by two facilities:

- Guyenne pipeline (Lussagnet Roussines),
- Gascony and Midi pipelines (Lussagnet – Lias – Saint-Martin-de-Crau).

The Guyenne pipeline has a capacity of 230 GWh/d in the TIGF to GRTgaz South direction and 150 GWh/d in winter, in the reverse direction.

The Midi pipeline: 180 GWh/d in winter in the GRTgaz South to TIGF direction; 30 GWh/d in the reverse direction.

4.1.5. **Fos entry point**

The admissible capacities during summer at FOS are an aggregation of these flows:

- 140 GWh/d on the Rhône pipeline,
- 190 GWh/d on the midi pipeline,
- a minimum of 60 GWh/d for PACA zone consumption,
- 20 GWh/d for injection into the storage facility at Manosque.

The firm entry capacity at Fos PITTM is 410 GWh/d

The operation of Fos Cavaou at nominal capacity (so far limited to 20%) should improve the balancing of the GRT South zone and release the pressure on North/ South exchanges.

4.2. Terminology

4.2.1. **Saturation of a facility**

Saturation occurs when a facility is operating at its maximum physical limits.

4.2.2. **Congestion**

Definition of regulation n° 1775/2005:
“Physical congestion: situation where the level of demand on actual supply exceeds technical capacity at a given moment.”

4.3. Study methodology for network development

4.3.1. **GRTgaz methodology**

The calculation of entry and exit capacities for the main GRTgaz transmission network is done by carrying out a thorough analysis of a combination of flow schemes that ensure supply to consumers in each of the entry and exit zones at all levels of consumption.

An increase in the entry, exit or link capacity in the main GRTgaz transmission network will lead to a development of transport facilities based on the calculation of

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the non-developed capacity as described above and identifying facilities for construction or development according to the following operating method :

Terminology:

- Network Operation Limit Condition (NOLC) = benchmark flow scheme for entry, exit or north/south link where a certain number of facilities are saturated. It is associated with a very low likelihood of occurrence,
- Network Operation Normal Condition = realistic distribution of flow,
- Core of the network = portion of the main network that is useful for more than one entry or storage point.

Method:

- The first stage consists of verifying the physical capacity of the connections between entry points and the core of the network,
- The second stage consists of conducting thorough research into the physical limits at the core of the network in order to establish which saturated facilities require development.

Details of the calculations carried out by GRTgaz are as follows:

1-Determining the NOLC

Defining the major areas of saturation and distribution of sources of pressure on the network (East/West saturation, ……) by seeking a local minimum or benchmark supply scheme => combination of the most penalizing flow.
Sensitivity tests, parameter by parameter, around this benchmark scheme.

2 NOLC occurrence study:

1- Creating equations for the Limit Condition (NOLC),
2- Modeling of variables for the problem (creating equations for the entry variables depending on historical behavior and known forecasts).
3- Determining and modeling the links or mathematical independencies that exist between each of the variables (comprehensive).
   Reference to market behavior if possible, otherwise careful modeling for dimensioning (conservative),
4- Choosing of the numerical resolution method:
   - Analytical method possible for local constraint (few variables),
   - Monte Carlo type method for core network issue (very high number of random simulations),
   - Result = probability of achieving or exceeding NOLC,
5- Ensuring that the result obtained at stage 4 is robust,
6- Determining the most influential variables.

3-Dimensioning the core network

1- Determining the local minimum so as not to exceed each NOLC,
2- Relevance of development choices:
    - Choice of phased reinforcement plan,
    - Recalculating of the NOLC and NOLC probabilities as for previous stages,
3- Prioritizing and choosing reinforcements.

This is used to derive a reinforcement strategy for the main GRTgaz transmission network combined with developing entry, exit and link capacity.

4.3.2. **TIGF methodology:**

The TIGF procedure has a similar aim to that of GRTgaz.
The essential difference between the two operators is network complexity, hence the number of scenarios in the study and, by the same token, the tools required for verifying and validating the occurrence of the said scenarios.

The main particular feature of the TIGF zone is obviously the central location of the storage facilities at Lussagnet and Izaute. Consistency between transmission and storage development scenarios is afforded by an analytical method based on flow schemes.

Developments are determined from flow scenarios that, at different periods of the year in question (Winter/inter-season/summer weather risk P2, P10,) incorporate the following hypotheses:

- Changes to France/Spain transmission (Open season),
- TIGF zone consumption,
- Supply to the zone by GRTgaz, Spain and Lacq production output (decreasing production from the Lacq Plant until final closure on the 31st of December 2013),
- Changes to storage requirements from shippers (outside TIGF zone),
- modulation and flexible supply requirements of the consumers within the zone.
- Contractual commitments with adjacent operators (transfer and modulation supply services, rules for distribution of flow to network interconnections, support agreement).

Each pipeline is dimensioned to ensure published sale capacities (pipe development + compression).

Types of flow that are a problem for transmission:

- winter conditions for flows from the TIGF zone (Lussagnet to adjacent networks), because the capacities sold at exit points must be aggregated with regional zone consumption,
- summer conditions for entering flows (adjacent network towards Lussagnet), because all of these flows must be transmitted to the storage facilities (low consumption).

The aim of the flow scenarios is to optimize development at the Lussagnet plant and/or compression at Lussagnet dedicated to major transmission pipelines.

Each flow delineating an entry to or exit from the zone is created by contracted exchanges initiated by the shippers. Entry/exit flow, entry flow towards storage, storage flow towards the GRT South zone or Spain.

TIGF uses the flow schemes to analyze the concomitance and interaction of these exchanges, the physical impact of which on the network might be reduced by contra-flow generated between them (transmission from Spain to GRTgaz as a contra-flow to supply the TIGF zone via the GRTgaz network).

5. Study phase 1

5.1. Developing a simulation tool

The decision was taken to use a GRTgaz application in Excel to set up a unique simulation model - called MUST. (Unique Transport Simulation Model).
As the GRTgaz network characteristics data was already up to date, TIGF extracted the required information from its own databases, which was then entered into the tool by GRTgaz.
TIGF and CRE received training on how the tool works.
A comparison was run between the MUST and TGNET results - the latter used by TIGF and gave similar results.
Both parties therefore validated the tool.

5.2. Research into congestion points in the existing network and flow problem scenarios

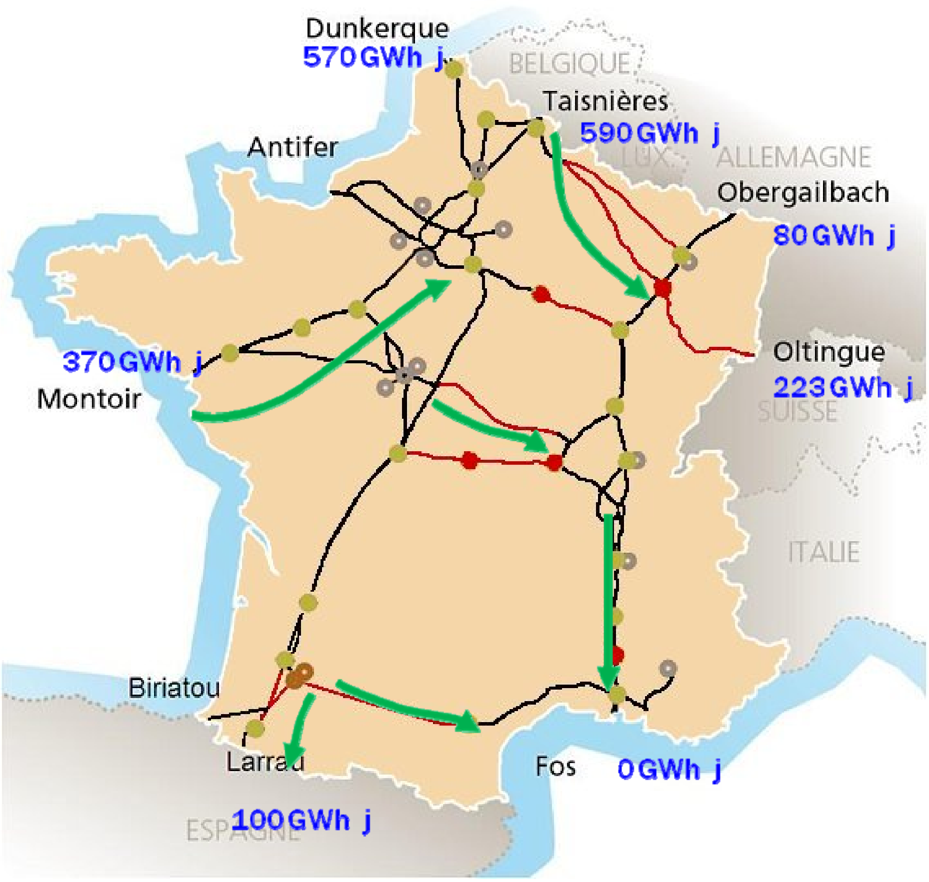
Two problem scenarios put forward by GRTgaz were supplemented by the TIGF network and re-evaluated according to the principles for determining NOLCs referred to above.

The working group considered that there was no point in using more scenarios, in the knowledge that the two scenarios considered were sufficiently decisive and descriptive of East-West saturations of the French network.

5.3. Description of characteristic flow scenarios

Scenario 1 - Obergailbach minimum 10% risk

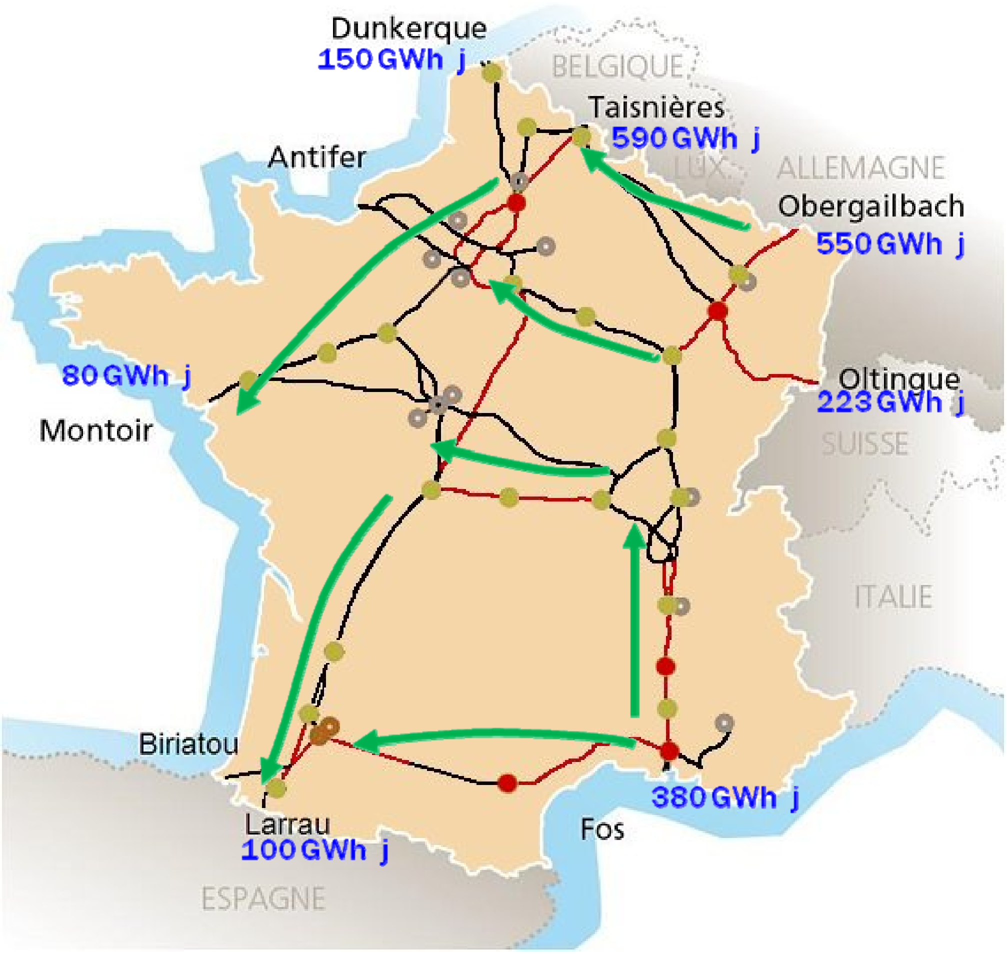
Obergailbach is an entry point to the network for which GRTgaz has identified a major risk of supply failure. For the given climate-related consumption conditions, GRTgaz is seeking to determine the minimum supply via this point that is required for balancing the different zones.
Any reduction in entry via this point will entail flow from West to East, saturating existing facilities.
Where no gas is entering via Fos, the entire TIGF network is supplied by the Lussagnet storage facility. This results in saturation of the "Gascony pipeline".
Note: taking the TIGF network into account in the Obergailbach minimum scenario has significantly reduced congestion to a 2% risk (from 110 GWh/d to 80 GWh/d). On the other hand, there is no change at higher temperatures. This is why the temperature hypothesis used in this report attracts a risk level of 10%.



In this scenario, there is no flow between TIGF and GRTgaz zones.
The items in red represent saturated facilities.

Scenario 2: Summer, consumption for the month of August –Montoir minimum

All entry points are at their maximum value except for Montoir, where the minimum acceptable for operating the network is 80 GWh/d and Dunkirk having to be reduced to 150 GWh/d to balance the zone.
A reduction in supply at the Montoir LNG Terminal unbalances the supply to Chémery in an injection period.
Gas must be transmitted from the Fos terminal up to Chémery.
Flow is impeded by instances of saturation across all of the facilities linking Fos to Chémery in both the GRTgaz South and TIGF zones.

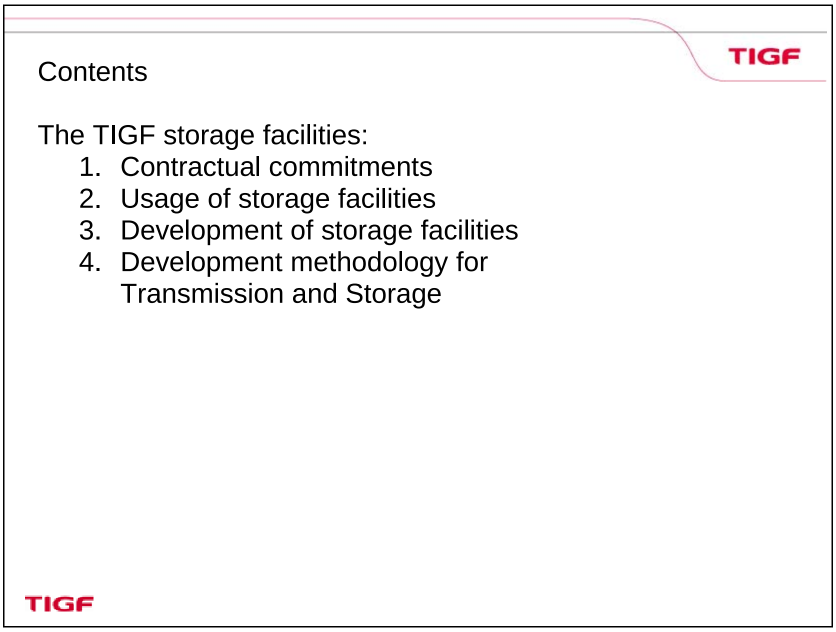


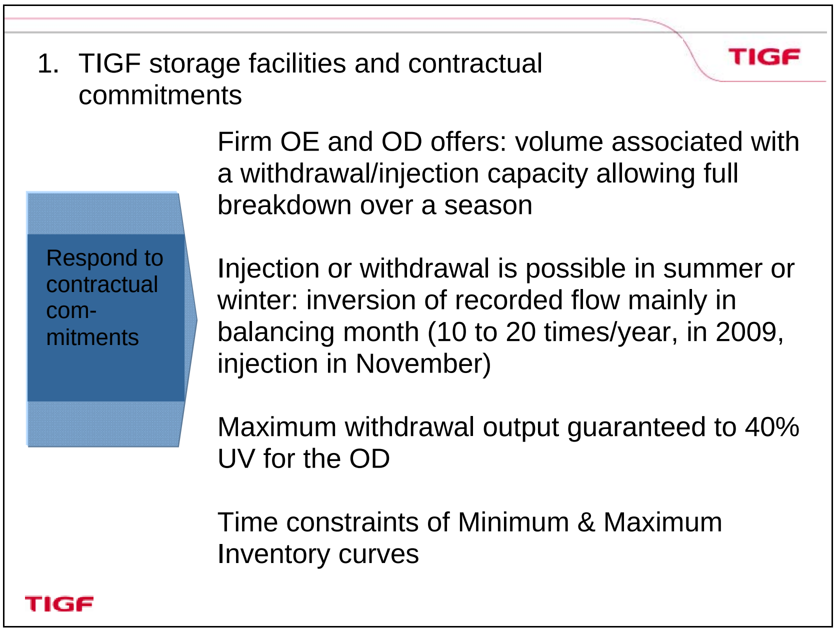
The items in red represent saturated facilities.

5.4. Formalization of flows to Transmission and Storage Interface Points (PITS) taken into account in the study.

In preparation for phase 2, TIGF, GRTgaz and Storengy presented the following storage facility operation models:

5.4.1. **Model used by TIGF**

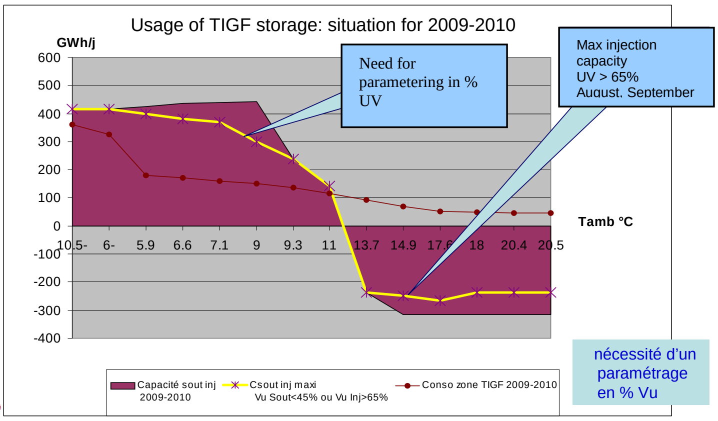




2. Usage of TIGF storage facilities: statistical demand

TIGF

Non climate-related usage, only constrained by following Minimum & Maximum Inventory curves Excess storage: the TIGF only has a right to volume of 45%. No Transmission/Storage constraint => PITS publications => storage capacities



TIGF

3. Development of TIGF storage facilities: 2009 to 2015

TIGF

- Increase in usable volume
- And/or increase in withdrawal and injection capacities
- Development in flexibility of installations and IS tools:
  - Respond to demand from Transmission, Storage, CCCH shippers

Subject to:

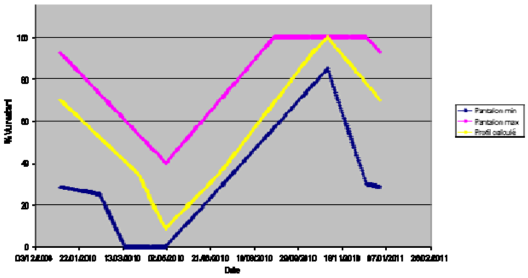
- Favourable Open Season results and Transmission developments
- Results of storage auctions, adapted offers
- Results of conceptual and feasibility studies
- Tariff structure and levels

Consistency of Transmission and Storage development guarantees that there is no PITS constraint

TIGF

2003-2008 average profile and temperature/date correspondence

- The average increased profile is used to establish the UV=f(date) correspondence
- The temperature in the TIGF zone (30 year average) is used to obtain temp=f(date)



années 1972 à 2001	janv	févr	mars	avr	mai	juin	juil	août	sept	oct	nov	déc
Temp moy Cazaux, Pau, Tlse	5.9	7.1	9.3	11.0	14.9	18.0	20.4	20.5	17.6	13.7	9.0	6.6

TIGF

5.4.2. **Model used by GRTgaz**

The Transmission Storage interface – GRTgaz
Climate capacity:

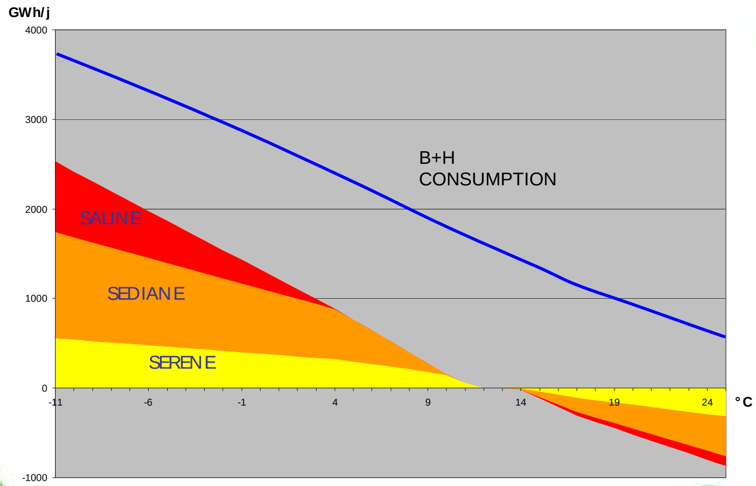
- Injection is only guaranteed in summer, withdrawal in winter.
- The max injection level (to 55% of UV withdrawn) is only guaranteed for minimum consumption (average August consumption).
- The maximum withdrawal output is only guaranteed for maximum consumption (Consumption on a cold day at annual 2% risk).
- The guaranteed withdrawal output depends on the temperature. It increases in a linear fashion from the starting temperature of storage (around 4 degrees C for saline, 10 to 12 degrees C for Aquifers). The starting temperature of each storage facility is determined so that it can be emptied during a cold winter at 2% risk.

The Transmission Storage interface – GRTgaz

Climate capacity:

Whatever the climate conditions, in winter, GRTgaz authorises an emission to the PITS between 0 and the climate capacity (depending on the temperature on the day in question) ; in summer, an injection to the PITs between 0 and the climate injection capacity (corresponding to the consumption level of the zone in question).

Note: GRTgaz guarantees climate injection capacity within the limits of the homogenous distribution (pro rata to its climate capacity) of emissions/injections of the PITS. within the same zone.



5.4.3. **Option proposed by Storengy**

Transmission Storage interface
STORENGY approach (1/5)

Climate capacity:

STORENGY would like the PITS access capacity to be non climate-related i.e. always available, without any restriction on transmission on the order for storage – for injection and withdrawal.

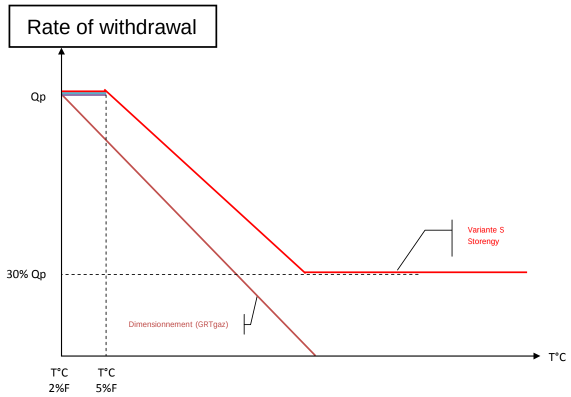
Given that this option is close to that of TIGF, Storengy would like a study to be conducted on an intermediary option between the GRTgaz and TIGF versions, should the latter not be taken up.

Transmission Storage interface
STORENGY approach (2/5) – to withdrawal

Peak output (Qp to 45% of VU) guaranteed at daily Temperature 5% cold.

Linear relationship between output guaranteed to PITS and T°C, so as to guarantee withdrawal of 100% of UV in a warm winter 2% up to a minimum value of 30% of the Qp.

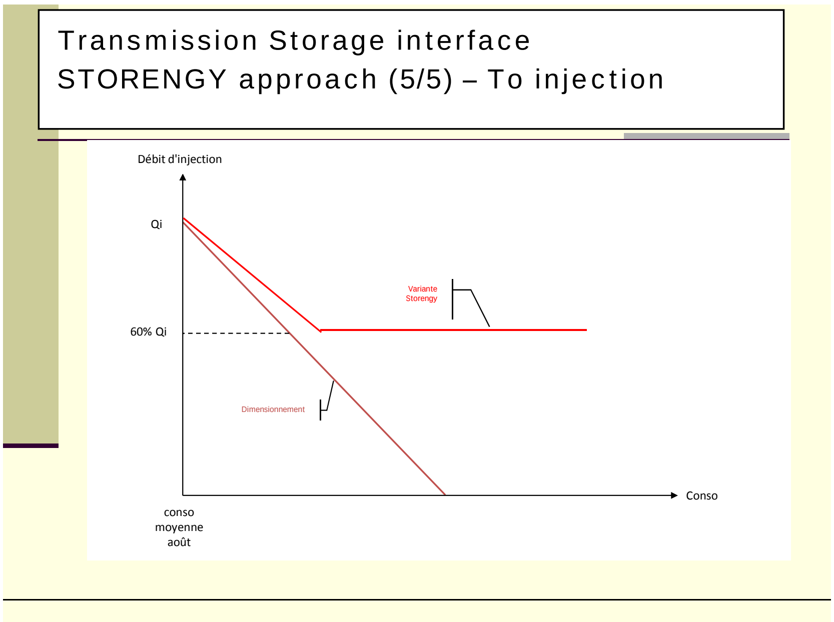
Transmission Storage interface
STORENGY approach (3/5) – To withdrawal



Transmission Storage interface
STORENGY approach (4/5) – To injection

Peak August output (Qi to 50% of VU) guaranteed for average daily consumption for the zone in August.

Linear relationship between the output guaranteed to the PITS and consumption, so as to guarantee injection at 130% of UV in summer up to a minimum value of 60% of the Qi.



5.5. Conclusion of phase 1:

A joint main transmission network model was constructed by the two carriers. Using this model, the 2 TSO identified two scenarios that might prove to be problematic for the management of the transmission network with the structure implemented from the 1st of January 2009:

- scenario 1: risk 10% cold, Obergailbach minimum at 80 GWh/d

  Analysis reveals that joint management of the 2 networks could obviate the problem of the minimum flow of 150 GWh/d at Obergailbach (when only the GRTgaz network is taken into consideration) to 80 GWh/d. This scenario leads to saturation of the North/South link on the GRTgaz network, without any problems for the GRTgaz South/TIGF interface, given that the TIGF zone operates “self-sufficiently” (no flow between the 2 zones).

- scenario 2 : average summer, Montoir minimum at 80GWh/d leading to saturations on both TIGF and GRTgaz sides.

6. Study phase 2

6.1. Objective

The aim is to:

- Establish the status of the network after the planned investments coming in Q1 of 2011, Q2 of 2013 and Q4 of 2013,
- Identify problem flow scenarios,
- Propose investment or, failing that, operating rules for implementing CRE guidelines of the 2nd of July 2009.

6.2. Future development on the networks.

6.2.1. **For GRTgaz**

Q1 2011 : Fos Cavaou comes on line,
Beauce pipeline (Fontenay - Saint-Arnoult),
Mâconnais pipeline (Etrez-Génelard).

Q2 2013 : Chazelles compression station.

Q4 2013 : North pipelines tripled,
Cuvilly-Dierrey connection,
Dierrey – Voisines strengthened,
Beauce*, North East* and, Hauts de France* pipelines strengthened
Compression strengthened at Taisnières*, Cuvilly and Voisines*.

*These projects have to be confirmed and their realization will depend on the LNG terminal of Dunkirk.

6.2.2. **For TIGF**

Q4 2010: LACAL reversibility.

Q4 2012: Béarn pipeline Lussagnet / Lacq.

Q4 2013: End of extraction from the Lacq natural gas field,
Phase B of Guyenne pipeline.

6.3. Dates for review

April 2011: Lacal and Fos Cavaou reversibility
April 2013: Increase in capacity at Lacal and GRT South TIGF.
December 2013: Increase in capacity at Taisnières.

6.4. Capacity in the different study phases

		April -11		April -13		December-13	
		Entry	Exit	Entry	Exit	Entry	Exit
GRTgaz North	Dunkirk	570		570		570	
	Taisnières H	590		590		930**	
	Obergailbach	620		620		620	
	Montoir	370		370		370	
	Oltingue		223		223		223
	GRTgaz South	230	230	230	230	230	230
GRTgaz South	GRTgaz North	230	230	230	230	230	230
	Fos	410		410		410	
	TIGF	80*	325	255*	375	255*	375
TIGF	GRTgaz South	325	80*	375	255*	375	255*
	Larrau	100	100	165	165	165	165
	Biriatou	5	10	5	10	5	10

*Capacity to which is added 150 GWh/d of transfer service from Cruzy to Castillon for GRTgaz
** This value remains uncertain (see CRE deliberation of May 27, 2010)

Note:

Lacq generation was taken into account in the different study phases:

April 201: 16 GWh/d.

April 2013: 15 GWh/d.

January 2014: 0 GWh/d.

6.5. Modeling PITS (Transmission and Storage Interface Point) flow management

The plan is to compare the various options for the consistent management of storage facilities in the various French network zones (see chapter 5.4).

Following analysis by GRTgaz, it appears that the option proposed by Storengy leads to congestion within the GRTgaz North and GRTgaz South zones. It is therefore unlikely that this method of storage management will be implemented in the time frames under discussion.

In phase 2 of the study, the GRTgaz storage management model was therefore applied in the GRTgaz zones and the TIGF model in the TIGF zone.

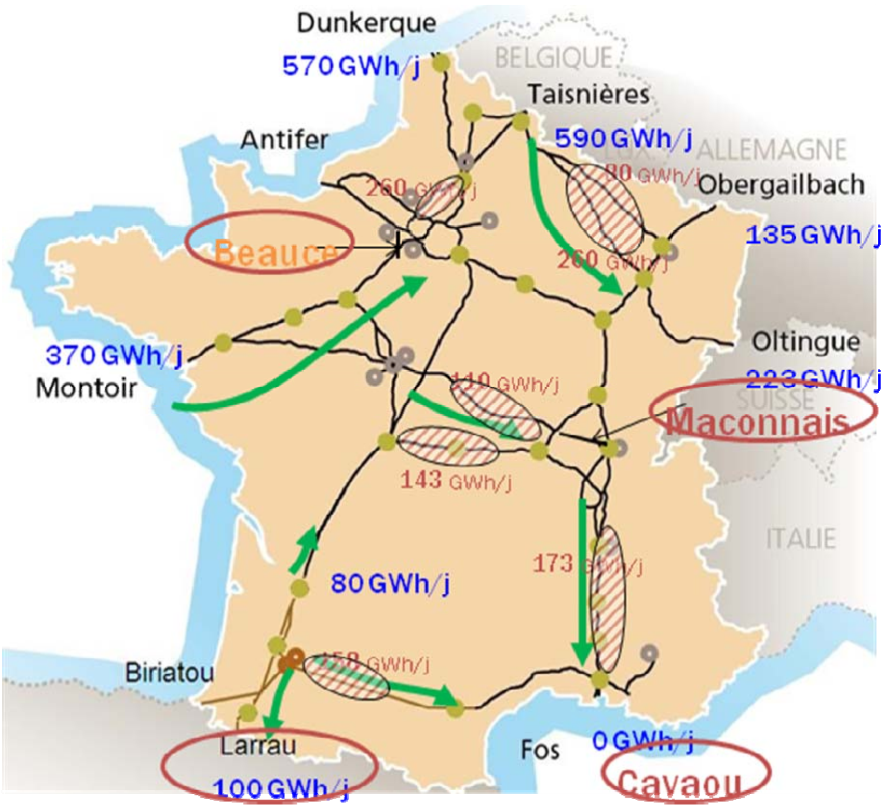
6.6. 2011 milestone

6.6.1. **Developments under consideration by this milestone**

Fos Cavaou goes on line at 100% of nominal capacity,
Beauce pipeline (Fontenay - Saint-Arnoult),
Mâconnais pipeline (Etrez-Génelard).
LACAL reversibility.

6.6.2. **Map of flow problem scenarios**

Characteristic scenario: winter 10% and flow problems from West to East under the current contractual structure.



This scenario is characterized by the absence of any entry of gas at Fos, a minimum of 135 GWh/d at Obergailbach and maximum use of capacity between the TIGF and GRTgaz South zones.

Analysis:
- The increase to the minimum at Obergailbach as against the 2% winter scenario for 2009 can be explained by the increase in flow to the West (TIGF capacity to GRTgaz South up from 30 to 80 GWh/d).

Congestion:
- This flow schema leading to the need for a minimum flow at Obergailbach leads to a congestion scenario on the network.

6.6.3. **Conclusion for 2011 milestone**

There is congestion at this milestone.
In accordance with the study specification, and because no investment was planned by this milestone, a study was made of the option to implement operating rules.

This was hotly debated, and its feasibility was not established, particularly with regard to the non-degradation of current transmission and storage offers.

On the other hand, the time needed for setting up the organization required by any operational rule was considered incompatible with such a close deadline.

The plan to remove the tariff term at the 2011 milestone has therefore been dropped.

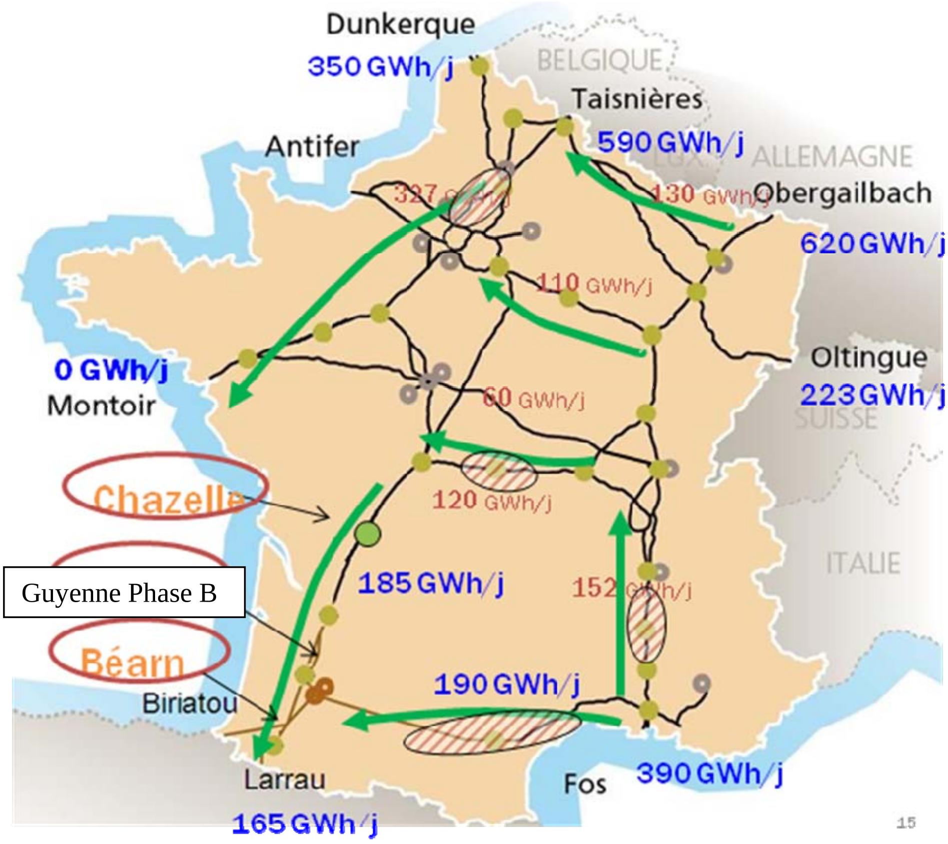
6.7. 2013 milestone

6.7.1. **Developments under consideration by this milestone**

Béarn pipeline (Lussagnet - Lacq),
Chazelles compression station,
Phase B of strengthening the Guyenne pipeline.

6.7.2. **Map of flow problem scenarios - Summer**

This map shows saturation points at the GRTgaz North – GRTgaz South, GRTgaz South – TIGF and TIGF-Spain connections (summer scenarios). No gas entry at Montoir. Contractual structure remains unchanged.

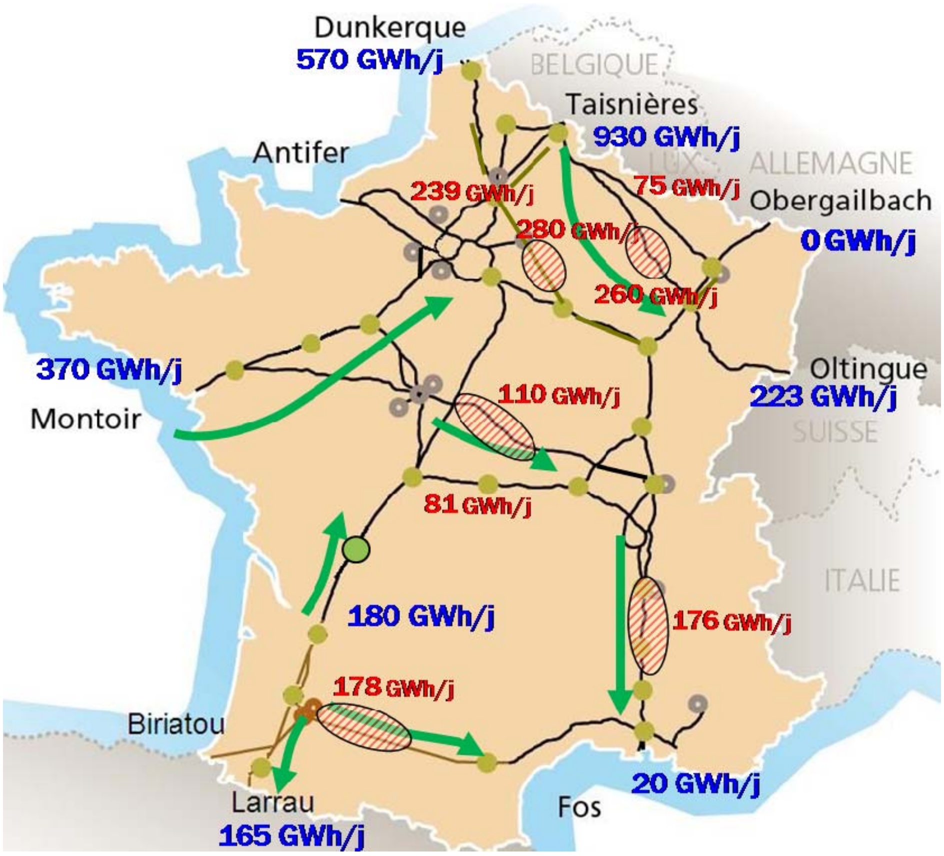


This scenario maximizes the GRTgaz North – GRTgaz South, GRTgaz South – TIGF and TIGF-Spain connections, and there is no gas at Montoir.

At the 2013 milestone, no congestion is identified in the problem scenario for summer.

6.7.3. **Map of flow problem scenarios - Winter**

Example: characteristic scenario N°1: 2% winter climate risk and flow problem from West to East, current contractual structure.



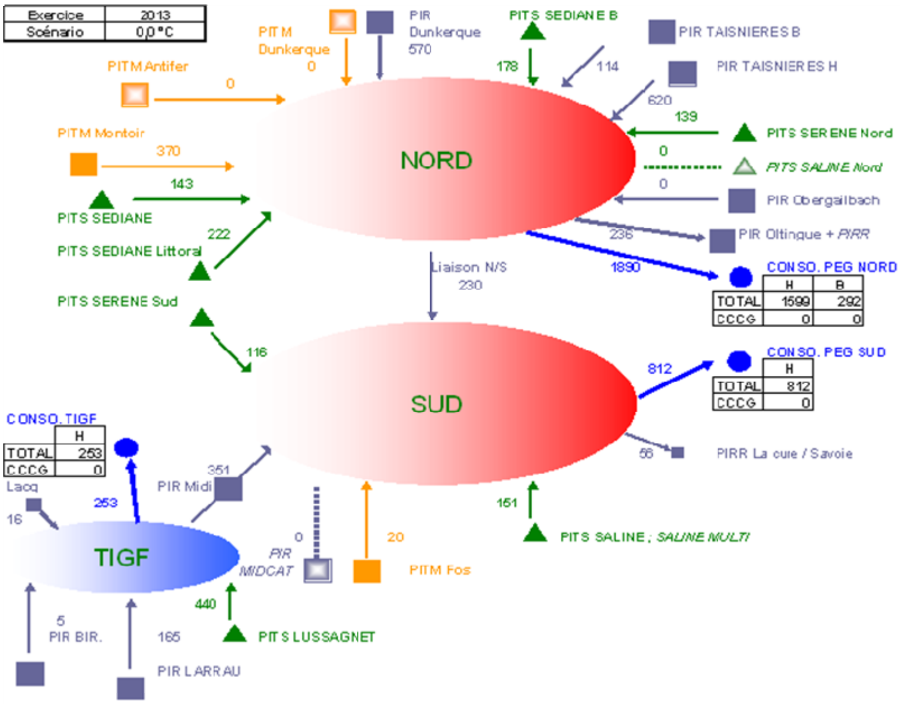
This scenario maximizes the GRTgaz North-GRTgaz South and TIGF-Spain connections, flow is directed from West to East, and there is no gas entry at Obergailbach.

This scenario does not give rise to any congestion on the French transmission network.

At the 2013 milestone, no congestion is identified in the winter problem scenario.

The results of the open season procedure being taken into account, the capacity developed in Taisnières at the 2013 milestone are different from the assumption made for the study (see CRE deliberation of May 27, 2010).

Characteristic scenario N°2: winter temperature 0°C, entry on the network: 100 % Lussagnet, Fos minimized, tariff term to 0

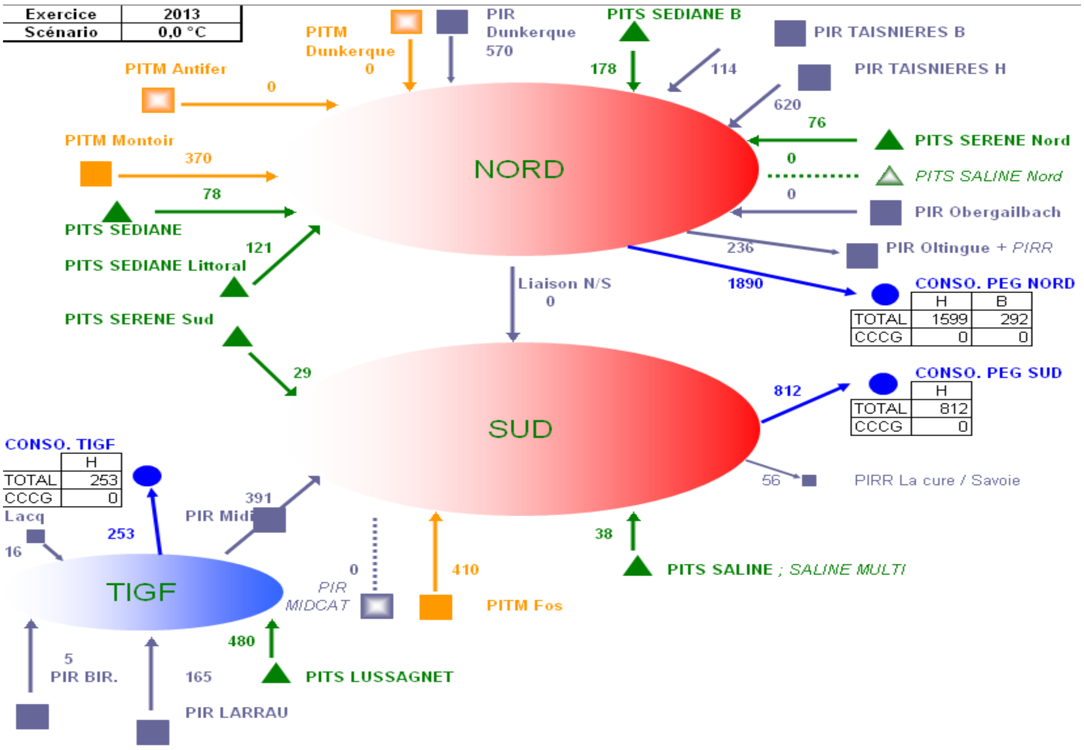


100% gas entry from Spain, 100% withdrawal from Lussagnet; minimum entry from Fos

➔ Firm sellable capacity at the Midi network interface point under current contractual framework is exceeded (congestion), but this flow schema is physically acceptable, becoming contractually possible from the start, where tariff term is set to zero, where unused capacity reserved for transfer of entry at Fos is made available in this scenario.

This scenario does not give rise to any congestion on the French transmission network.

Characteristic scenario: winter temperature 0°C, entry to network: 100 % Lussagnet, Fos minimized, tariff term set to 0



	H	B
TOTAL	1599	292
CCCG	0	0

	H
TOTAL	812
CCCG	0

	H
TOTAL	253
CCCG	0

100% gas entry from Spain, 100% withdrawal from Lussagnet; maximum entry from Fos, reduced withdrawal from storage in GRTgaz zone ➔ Physical capacity of connection facilities exceeded, congestion situation where tariff term is set to 0 for an unlikely scenario.

6.7.4. **Conclusion at the 2013 milestone:**

- At the 2013 milestone, subject to carrying out work as planned in the GRTgaz North zone, saturation in this zone will be reduced. There will no longer be a minimum at Obergailbach or Montoir.
- At this milestone, network development means that it can easily support flow foreseeable under the contract with the current tariff structure.
- However, it was still established that a number of scenarios, although most unlikely, show the need to devise operating rules for a case where the tariff term is set to 0 at the connection. Note: at this milestone, only an operating rule can be proposed, and new investment plans cannot be implemented, given the completion deadlines.

6.8. Consideration of the imbalance causing demand from COPIL on constraints on the TIGF storage facilities

6.8.1. **Terminology**

Technical capacity: maximum theoretical physical quantity of gas that it is possible to transmit at a facility.

Sellable firm capacity: portion of technical capacity at a facility that is guaranteed "any time anywhere" and offered for sale to transmission network users (i.e. maximum output that a facility is likely to transmit in a given benchmark scenario known as a "dimensioning case")

Dimensioning case: case determined by carriers under the most difficult operating conditions that they have to guarantee.

6.8.2. **Significance**

In the GRTgaz South zone, the flows taken into account in terms of entry to/exit from the underground storage facilities are based on climate-related hypotheses.
In the TIGF zone, the flows are taken into account in terms of non climate-related capacity published at the PITS.

In the context of setting the tariff term to zero at the GRTGaz South – TIGF connection, the working group was asked to study the feasibility of managing flow at the connection with the following imbalances, which result in constraints on the use of the storage facilities in the TIGF zone:

Storage withdrawal < Consu + Q Exit_Spain + Q TIGF connection → South – Q Lacq;
Storage injection < Q Entry_Spain + Q South connection→TIGF + Q Lacq – Consu

Where

Q South connection→TIGF: flow within limit of capacity sold at connection of South zone with TIGF (including transfer service)
Q TIGF connection→South: flow within limit of capacity sold at connection of the TIGF zone to the South (including transfer service)
Q Exit_Spain: flow within limit of capacity sold on exit to Spain (Larrau+Biriatou)
Q Entry_Spain: flow within limit of capacity sold on entry from Spain (Larrau+Biriatou)
Qlacq: flow emitted at Lacq (see phase 1 stage report).
Consu: Consumption in the TIGF zone.

These imbalances are a reflection of the TIGF zone balancing on the one hand and connection capacities towards GRTgaz South on the other. However, these imbalances do not in themselves make it possible to manage operations in the two zones when setting the tariff to zero at the connection. Other management rules applicable in the TIGF and GRTgaz zones will have to be devised under this study.

In the GRTgaz South zone, adhering to the dimensioning flows allowed for by GRTgaz from and towards the PITS in the South zone guarantees the availability of firm capacity shown across all of the other points (PIR and PITTM).

6.9. Operating rule (Feasibility study)

This rule, as outlined to date, should serve to manage non-limited nominations at the interface point by peak shaving excesses in cases of strong demand beyond technical transmission capacity.

The principle of this rule would be:
- No prior transmission capacity subscription required at the interface point,
- Nominations maintained but without limit to capacity,
- If total nominations are greater than the available physical capacity, peak shaving of any excess pro rata to each request, based on all available capacity (firm, interruptible and re-use of GRTgaz transfer service if not used), account taken of cases of restricted capacity during work periods.

Planned operating rule

Mechanism

- Maintain nominations at Midi PIR
- Determine available operating capacity at D for D+1 at Midi PIR (firm and interruptible)
- Where operating capacity is exceeded at Midi PIR on day D, recalculate quantities scheduled pro rata to nominations from each shipper
- Peak shaving leads to symmetrical imbalance of shipper accounts in each zone, option for shippers to rebalance through revised nomination

Planned operating rule

Example of nominations

BILAN ZONE SUD	Shipper 1	Shipper 2	Shipper 3	TOTAL	Capa	Dépassement
Conso	500	300		800		
Fos	0	-210	-200	-410		
Liaison N-S	-230			-230		
PIR MIDI	0	210	200	410	375	35
Stockages	-270	-300		-570		

Excess

+ symbol: network exits
_ symbol: network entries

Planned operating rule

Allocations in a case of excess:

BILAN ZONE SUD	Shipper 1	Shipper 2	Shipper 3	TOTAL	Capa	Dépassement
Conso	500	300		800		
Fos	0	-210	-200	-410		
Liaison N-S	-230			-230		
PIR Midi	0	192,07	182,93	375	375	0
Stockages	-270	-300		-570		
Bilan	0	-17,93	-17,07	-35		

+ symbol: network exits
_ symbol: network entries

7. Conclusions

7.1. General conclusion

In order to respond to a request from the DGEC sent to the two carriers[1], GRTgaz and TIGF conducted a joint study in September 2009 and June 2010 to simulate the operation of their gas transmission networks at the 2011 and 2013 milestones. The aim was to evaluate the risk of congestion and operating methods for operating the two transmission networks for a scenario involving the disappearance of the tariff link between their zones, as proposed by CRE in its deliberations of the 2nd of July 2009.

To this end, the two carriers shared a joint model for analyzing the network, exchanged the characteristics of their facilities and set the nomination and flow scenarios to be taken into account. A team of analysts provided by both carriers conducted this study under the guidance of a Management Committee, joined by representatives from the DGEC, CRE and Storengy.

The study showed that by taking the two networks into account, the minimum flow required at Obergailbach can be reduced as early as 2009 (110 to 80 GWh/d).

At the 2011 milestone, the study confirmed the instances of saturation identified by the TSOs on their respective networks, and there is still a congestion scenario at this milestone (Obergailbach minimum).

By 2013, the flow schemas studied showed that there was no risk of congestion to the structure between the GRTgaz South and TIGF zones. Nevertheless, the disappearance of the connection tariff term leads to the disappearance of any control over capacity at the Midi PIR and there might be a risk of congestion for the following specific configurations: (i) during maintenance work reducing the physical capacity of facilities (ii) in winter – if entry nominations from Spain and Fos and withdrawals from TIGF storage facilities are simultaneously at maximum level, when there has been no call on gas withdrawal from Storengy storage facilities and there is no gas flow from the de GRTgaz North zone.

However, the positions of the TSOs are contrasted. They are set out in the following paragraphs.

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[1] *"I would ask you to… set up a joint model for the French gas network and conduct study before mid 2010, based on that model, to define the appropriate flow scenarios and assess the risks of, taking account of both the physical reality of the networks and changes in flow rates"*

7.2. GRTgaz stance on the operating rule

The joint study conducted by the two carriers leads to the conclusion that there is a need for an operating rule for managing any highly exceptional instances of congestion that might arise if the tariff term disappears by 2013.

GRTgaz is prepared to study an operating rule that would allow for the disappearance of the connection tariff term, but GRTgaz cannot meet this objective on its own.

7.3. TIGF stance on the operating rule

The constraints on managing a network can be incorporated in contractual arrangements in two ways:

- Via rules on capacities (subscription management),
- Via rules on nominations (allocation management).

Doing away with the obligation to subscribe to capacity at the GRTgaz-TIGF interface produces network constraints on allocation management.
Implementing an operating rule requires (i) setting up a system for limiting subsequent rather than prior nominations and therefore transforming today's firm capacities into interruptible capacities, (ii) the establishment of rules for prioritizing allocation for cases of peak shaving.

This raises a number of issues.

From the TIGF point of view

- The occurrence of peak shaving was evaluated on the basis of past flows and considered to be low. Is increased fluidity of the market likely to change flows and increase the risk of occurrence?
- Can peak shaving pro rata to nominations change behavior by encouraging shippers to maximize initial nominations, with a view to making changes later in the day? How can this behavior be prevented?
- How do we make a distinction between nominations that might be peak shaved from those that cannot (OSP, MIG)? How do we prioritize?
- How do we evaluate and communicate the impact of works on operational capacity in advance, given that we are only aware of it on a daily basis, in terms of the transmission right that GRTgaz exercises?
- Up to what point can revised nominations be accepted? Does each revised nomination have to trigger a new peak shaving calculation? How can endless changes be avoided?
- What will the impact of uncertainties relating to other Interface Points be?
- links with Spain
- PITS management
- What will be the costs of these developments to OPEX? Via the 3x8 of the TIGF Middle Office?

- How do we manage the increased number of messages that we can expect?
- How do we allocate everyone's responsibilities if there is a problem?
- How do we handle the issue of capacity reductions when unannounced work or maintenance is carried out?

From the shippers' point of view:
For the PIR concerned, this rule entails no longer using the "allocation = nomination" principal

- How does the shipper manage this risk of being peak shaved?
- How will the shipper manage balancing?
- If there is no PEG or storage facilities availability, how can we rebalance at an acceptable price?
- How do we obtain guarantees of fairness for peak shaving?

Also, revising the GRTGaz investment plan down (Taisnières to 640 instead of 930 GWh/d) was not allowed for in the calculations in the studies on congestion. Plus, TIGF is insisting on the benefit of re-updating the investment data and the maps relevant for 2013.
It is clear that the conclusions are subject to the due implementation of investments in such a way and by such a time as technically specified.

As a conclusion, TIGF remains firmly opposed to doing away with capacity subscriptions at the interface with GRTgaz – both in defense of the company's own interests and because the benefit to the market remains unproven, given that the easing of the subscription constraints is replaced by increased constraints in terms of gas flow allocations and the loss of a clear overview of such allocations.

8. Annexes

8.1. General memo

DIRGAZ 18 September 2009

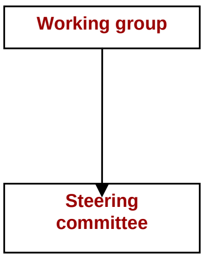
Study relating to French gas transmission networks
General memo
Version following the meeting on the 14th of September 2009

I. Study aims:

Conduct a study based on a joint model of the French gas network and the appropriate flow scenarios in order to:

- identify areas of major congestion on the French gas transmission network in the short and medium term,
- evaluate the conditions for implementing the guidelines issued by CRE on the 2nd of July 2009 concerning the management of the interface between the GRTgaz South and TIGF zones from the 1st of April 2011,
- and propose remedies (10-year plan).

II. Organization of work:



Working group

- **Composition:** representatives from TIGF and GRTgaz + 1 CRE mission officer (to be appointed) to coordinate work and monitor the plan
- **Missions:**
  - Carry out work required to meet the aims of the study in accordance with the plan set by the Management Committee;
  - Identify any risks and obstacles in the way of completing the study;
  - Propose solutions for review by the Management Committee.

Steering committee

- **Composition:** representatives from TIGF, GRTgaz, the DGEC and CRE
- **Mission:**
  - Ensure that work progresses smoothly to meet planning and study objectives;
  - Settle any disputes;
  - validate analyses and proposals from the working group;
  - validate study results and conclusions ;

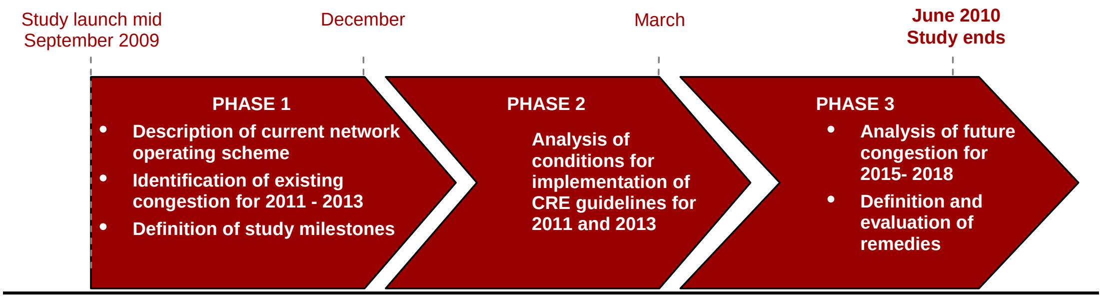
Note: Storengy is to be kept informed of the progress of the study and, if required, may be asked to join the steering committee.

The Steering Committee will meet once a month from when the study is launched on the 14th of September 2009. The 1st meeting dates planned are:

- 9th of October at 16.00 at CRE (video conference),
- 16th of November at 16.00 at CRE (video conference),
- 17th of December 13.00 at CRE (tray meal).

The working will meet as often as it needs to.

III. Study planning and scope:



1. Phase 1:

The aims of this phase are:

- to share and validate a joint model for the French gas transmission network based on the existing network:
  - ➢ formalize the existing annual and/or seasonal capacities for 2009 at each network entry and exit point (PITM, PITS, PIR, link between the North and South zones on the GRTgaz network and interface between the GRTgaz South and TIGF zones),
  - ➢ Formalize the flow scenarios used to determine capacity (consumption, temperature, entry and exit flow at each network connection point etc.),
  - ➢ set the other major parameters used to define the levels for this capacity: minimum/maximum pressure levels etc. ;
- to share and validate a joint view of existing areas of congestion: describe congestion identified on the network and current operating methods;
- to define and validate the milestones for review in terms of future transmission network development. Milestones identified so far are as follows:
  - ➢ April 2011: reverse capacity goes on line at Larrau, Fos Cavaou in service and milestone applied by CRE in its guidelines of 2 July 2009,
  - ➢ April 2013 and December 2013: inclusion of open season at Taisnières H and development of West area of interconnections with Spain,

Note: capacity is sold at a daily minimum rate. For this reason, the capacity of the networks to offer intraday flexibility is not within the remit of this study.
Also, a major principle of implementing entry/exit zoning is the non-degradation of the existing offering when new investment is made.

The study should also take account of the following aspects:

- The basic climate-related operation of storage facilities for determining injection and withdrawal capacities.
- As an alternative, by 2013, the scenarios used in the study should provide a certain additional marginal flexibility for withdrawal and/or injection within existing Minimum & Maximum Inventory curves in storage offerings (this

flexibility is to be defined precisely in this study with the two storage operators).

- The scenarios used in the gas PIP in 2009 concerning the consumption and number of gas-fired electric power stations (the number of planned gas-fired stations to take into account will be reviewed in terms of the information communicated to the carriers by project managers).

2. Phase 2:

The second phase has the following aims:

- To define the status of the network on the 1st of April 2011 based on the network model validated in phase 1 and major developments affecting the network at this milestone: annual and/or seasonal capacity at each network entry/exit point (PITM, PITS, PIR, link between the North and South on the GRTgaz network and the interface between the GRTgaz South and TIGF zones).
- To identify and describe any operating constraints that there might be by this deadline at the interface between the GRTgaz South and TIGF zones.
- To identify any operating constraints that might affect other transmission network interconnection points if CRE guidelines of the 2nd of July 2009 concerning the interface between the GRTgaz South and TIGF zones are implemented.
- To propose investment (with the 1st estimate of cost/times) and or operating rules that might be needed to enable implementation of these guidelines by minimizing constraints on other network interconnection points.
- An identical status report will be produced for the milestones of April 2013 and December 2013.

3. Phase 3:

The aims of this phase are:

- To establish the status of the network at the 2015 and 2018 milestones based on the model validated in phase 1 and any major developments affecting the network at these milestones: annual and/or seasonal capacity at each network entry/exit point (PITM, PITS, PIR, link between the North and South zones on the GRTgaz network interface between the GRTgaz South and TIGF zones).
  - April 2015: take account of LNG terminal at Dunkirk, extension of the terminal at Montoir, extension of life of the Fos Tonkin terminal to 5.5 Gm³ and the development of the East axis with Spain (depending on current events, plans for inclusion at the April 2015 milestone might change), development plans and storage capacity.
  - April 2018: overview based on TSO10-year plans.

- To identify and describe any operating constraints that there might be at either milestone in terms of the various network interconnection points.
- To propose solutions that might be implemented to do away with network congestion (with the 1st estimate of cost/times).

III. Proposal by GRTgaz to use its modeling tool:

GRTgaz announced that it had already modeled around 85% of the French transmission network in an IT tool. It proposed to TIGF the inclusion of additional data relating to the TGIF network in its model in order to create a joint model. TIGF could send network engineers to GRTgaz to work with people in charge of this area. This cooperation would be subject to the signature of a confidentiality agreement between the two carriers.
TIGF confirms its willingness to look at this working proposal.

All information will be shared between the carriers in a transparent manner.

The members of the working group would be:

- GRTgaz: B Guerber, JB Joliot,
- TIGF: M Lagache, M Perronat, JM Laborde.

A detailed work plan up to end December 2009 will be drawn up by the working group and submitted to the management committee by 1st October 2009.