CHAPTER 2

DESCRIPTION OF THE STORAGE FACILITIES

AND OF THEIR OPERATION

2.1 FOREWORD

The Storage Company offers a Storage Service that relies on the coordinated, optimised use of the storage reservoirs currently undergoing regulation and enhancement of the Cushion Gas and of the Working Gas.

The storage activity is currently carried out through three conventional depleted, simple expansion gas reservoirs (Collalto Cellino and San Potito and Cotignola which are under concession issued by the Ministry of Economic Development (MSE).

The performance that are made available result from the optimised aggregation of the performances of the individual storage sites in concession to the Storage Company, determined taking into consideration the properties of each of them and taking into account the existing constraints on the surface facilities and on the wells.

To comply with the obligation to provide coordinated, integrated management of its capacities, prescribed by Article 12 Paragraph 1 of Italian Law Decree no. 164 of 23 May 2000 and to guarantee transparency and non discrimination to all System Users, the Storage Company has defined a single virtual hub for access to the Storage System (Edison Stoccaggio Hub) through which the processes for reserving and assigning the capacities reserved by the Shippers. The Storage Company offers its services to the Shippers through the Edison Stoccaggio Hub regardless of which specific storage site is activated in injection or withdrawal.

This chapter describes the Storage System, its management procedures and the procedures for determining the offered capacities.

2.2 GENERAL DESCRIPTION OF THE STORAGE SYSTEM

Based on the provisions of Legislative Decree no. 164/00, the storage of natural gas in reservoirs or deep geological units is carried out on the basis of a concession issued by the MSE to the applicants who have the necessary technical, economic and organisational capability.

From an engineering viewpoint, a storage site consists of:

- The storage reservoir;
- The wells;
- The connecting flow-lines;

- The treatment and compression station.

The facilities comprising the Storage System were design and built, in consideration of the period in which they were conceived and of their specific use, on the basis of domestic and international industry standards, of the consolidated experience acquired and with the ultimate objective of guaranteeing an operation characterised by a high degree of security, reliability and operating efficiency.
A brief description of the aforementioned types of storage, reservoirs, wells and facilities is provided below.

2.2.1 The storage reservoir

The underground natural gas storage sites consist of geological structures having such characteristics as to allow the accumulation, conservation and, when required, the withdrawal of natural Gas.
Storage sites are considered conventional when they are built using depleted or semi-depleted gas production reservoirs, semi-conventional when depleted oil reservoirs or aquifer reservoirs (i.e. geological structures containing water) are used, special if they are built in abandoned coal mines and cavities obtained in underground salt formations.

2.2.1.1. *The different types of reservoirs and their problems*

Depleted gas reservoirs: the elements of most interest are the shape and the size of the reservoir, the breadth and the characteristics of the aquifer, the gas-water contact, the characteristics of the reservoir and cap rocks.
The physical parameters of the reservoir rock having most interest, to be carefully evaluated, are:

a. Interconnected porosity: the greater the interconnected porosity of the reservoir rock, the greater the natural Gas accumulation capacity;
b. Permeability: the greater the permeability of the reservoir rock, the more suitable it is to be used for storage;
c. Interstitial water saturation: it should be as low as possible, because it reduces the useful volume.

Another element to be considered is the “production mechanism” that influences the movements of the aquifer in the reservoir rock as a result of filling and emptying the reservoir. With reference to the production mechanism, the following are distinguished:

i. Simple expansion reservoirs, in which the aquifer remains substantially at the same level during the withdrawal and injection phases, allowing for high performance and fewer problems in production;

ii. Water thrust reservoirs, in which the aquifer rises rapidly during the withdrawal phase and must then be displaced during the injection into the reservoir. In these reservoirs, performance is limited by possible water entrainment (withdrawal phase) and by the pressure increase necessary to displace the water from the reservoir (injection phase).

With regard to storage sites in aquifers, it is necessary first of all to find the geological structure, better if anticlinal. This structure is identified with surface geological surveys, then located with geophysical systems.

The most important requirement of a storage site in an aquifer is impermeability to the passage of gas through the cap rocks which must have adequate thickness and low permeability, e.g. in the case of clay formations; this need is due to the fact that hydrostatic pressure is always exceeded in order to inject the gas.

For storage in salt formations, cavities are used that were obtained dissolving the salt mass with water pumped through one or more wells and then used to extract the salt.
Knowledge of the shape of the cavity and of the characteristics of the rocks that surround it are important factors to determine the minimum and maximum pressure at which this type of storage can be operated.
Generally, these storage sites do not have high working gas levels, but they do allow for sizeable peak flow rates.

Storage in partially or completely depleted oil reservoirs has similar characteristics to storage in gas reservoirs converted to storage; therefore, some of the operating and development methods that apply to the latter are valid.

In this case, the injection of gas into an oil reservoir can be a part of the project for the secondary recovery of the oil itself; in these cases, the typical advantages of storage are associated with those of the additional recovery of oil.
In addition, the treatment plants to give the necessary quality specifications to the gas, before it is placed in the transport network, are often different from those used in the above types of storage, because they must be able to retain the fraction of liquid hydrocarbons suspended in the gas.

2.2.1.2. *Technical management of conventional storage reservoirs*

Knowledge of the production parameters acquired during the primary production phase is essential for a correct technical management of conventional storage reservoirs.

The aforesaid parameters and those acquired during the storage cycles make it possible to monitor the dynamic behaviour of the sites, be they regulated on undergoing regulation.
Monitoring the behaviour of the reservoirs allows to implement appropriate models to simulate the behaviour of the reservoir in order to optimise use of available capacities, avoiding damaging the levels employed for storage.

The main phases that characterise each storage reservoir are:

- Injection Phase: during this phase, the reservoir pressure rises as the injected gas volumes increase and it is affected by the petrophysical/geostructural characteristics of the reservoir, by the production mechanism and by the compression capacity of the surface facilities. In particular, the receptive capacity of the reservoir decreases as the maximum pressure value is progressively approached; this value corresponds to the original static pressure of the reservoir or to any different value authorised by the MSE for the individual storage reservoir;
- Withdrawal phase: during the withdrawal phase, the reservoir pressure decreases as the volumes of gas withdrawn increase and it is affected by the petrophysical/geostructural characteristics of the reservoir and by the production mechanism. In particular, the withdrawal capacity of the reservoir decreases as pressure falls, inasmuch as it is a function of the difference between static and dynamic pressure applicable at the well head.

The evolution of the injection and withdrawal performance of each individual reservoir, therefore, is a function of the change in the volumes of gas injected/withdrawn over time and thus of the pressure level of the reservoir itself.

In the case of reservoir that are still undergoing enhancement, the injection and withdrawal capacity is limited mainly by the surface facilities, by the type of the wells and by the pressure conditions on the RNG to which the system is connected, while the reservoir pressure does not represent a real management constraint because, in the injection phase, it is still not possible to reach the original static pressure.

The parameters that characterise a storage reservoir are:

- Cushion gas;
- Working Gas;
- Peak availability.

Cushion gas represents the quantity of gas present in the reservoir, necessary to use the storage site, and it is the minimum indispensable quantity, present or injected in the reservoir upon starting the storage, that always be maintained in the reservoir. The function of cushion gas is to allow withdrawal of the working gas maintaining, in the reservoir, a given level of pressure to contrast the rise of the aquifer without compromising the properties of the storage reservoir over time.

Working Gas is the quantity of gas present in the reservoirs during the storage phase which can be made available and replenished to be used for Hydrocarbon, Modulation, operational balancing and Strategic Storage purposes, including the part of gas (called “pseudo working gas”) producible but in longer times than those required by the market, which is essential to assure the peak performance that can be required by the variability of demand in daily and hourly terms.

Peak availability is the quantity of gas the reservoir is able to withdraw and inject in one hour (the daily value is obtained multiplying the hourly flow rate times 24).

2.2.2 The wells

The wells connect the hydrocarbon-bearing levels of the reservoir with the surface structures and allow movement of the gas and the performance of other specific subsidiary activities such as the re-injection of reservoir water, where possible, and monitoring the reservoir.
Each well is provided in the surface with equipment to separate free water and/or condensation and with a control system directed by a unit capable of assuring the overall protection of the well and of the other equipment through a pneumatic-hydraulic control system.

The part of the well directly in contact with the hydrocarbon-bearing levels, called “completion” is specifically structured to allow the injection and withdrawal of the gas directly into/from the rocky formation.

The average depth of the wells is naturally tied to the depth of the levels used for storage and it is currently between 500 and 1500 metres below sea level.

From the technical point of view, the structure of the well can be represented as follows:

- externally, towards the traversed geological formations, the well consists of concentric hole sections, coated with steel pipes (“casing”) with a cement filling in the annular space between the formation and the

casing. The aforesaid filling assures the mechanical anchoring of the pipeline and hydraulic insulation from the formations it traverses;

- within the casing is positioned an additional steel tubing, called "completion tubing", whose purpose is to assure gas flow in conditions of complete security.

To assure the best performance, the wells for moving the gas are sometimes completed with "sand control" technique, by positioning at the bottom of the well appropriate filters ("gravel packs") able to retain the finest solid components of the rocky formation.
Production casings and tubings are connected on the surface to a series of valves that constitute the so-called "well head", to sole part of the well assembly that can be seen on the surface.

Each gas injection/withdrawal well is provided with appropriate safety valves, able automatically to shut off the flow of gas from the reservoir following any anomalies of the surface facilities directly connected with the well itself.

From an operational viewpoint, each well is operated with a pre-determined *delta P* (maximum pressure difference allowable between the static pressure and the dynamic pressure to avoid problems to the formation and to the well, while assuring the continuity of performance of the service) that takes into account the petrophysical characteristics of the involved level, of the production mechanism, of the type of completion and of the very location of the well with respect to the morphology of the level.

The wells present in the Storage System are classified according to their use:

- Operational wells, used to move gas both in injection and withdrawal;
- Monitoring wells, used to control the pressures and the degree of gas/water saturation in the hydrocarbon-bearing levels of the reservoir;
- Any wells for the re-injection of the water coming from the formation during the gas withdrawal phase, as a result of appropriate separation from the gas itself.

2.2.3 Connecting flow-lines

The wells, isolated or grouped in clusters, are distributed in such a way as to adequately cover the area of the reservoir and for this reason they may also be several kilometres away from the compression and treatment plants. To allow the movement of the gas between the wells and the plants, connecting pipelines known as "flow lines" are used.
These pipelines are provided their own cut-off valves and with security devices for management and control, both locally and remotely.

The size and characteristics of the flow lines are also significant. They influence the performance of the System because the Gas, en route, undergoes a head loss (pressure reduction) that is proportional to the flow rate of Gas transiting through the pipes.

2.2.4 Treatment and compression stations

In the storage station are installed all machines and facilities necessary to carry out the process and control operations for the injection of natural gas coming from the transport system in the underground reservoirs and for the withdrawal of the gas volumes from the reservoir to the transport network.
The main processes to which the gas is subjected in the storage stations are:

- Treatment of the gas to give it the necessary quality specifications before its injection into the National Network of Gas pipelines (or RNG);
- Compression in the reservoir and/or in RNG.

2.2.4.1. *Treatment stations*

The gas injected into the reservoirs is enriched with water and sometimes with higher hydrocarbons (which in the surface are condensed to gasoline) present in the interstices of the geological formations used for storage. The presence of water in the extracted gas is particularly accentuated in aquifers and in reservoirs with water thrust production mechanism.
For this reason the gas, before being redelivered on the RNG, must pass through the well head separators, the station separators and then through the treatment plants.

2.2.4.1.1. General information on the treatment plants

Treatment plants can be divided in first phase plants and definitive treatment plants.

First phase plants comprise:

- Separators;
- Heaters;
- Pumps for the injection of inhibitors of the formation of hydrates (glycol and/or methanol).

The task of the separators, normally installed at the well head and at the inlet/outlet of the treatment station, is to retain free water (or other liquids such as glycol and/or gasoline) and the water that condenses by effect of the fooling and of the decrease in the velocity of the gas due to the change in the diameter of the separator.

The function of the heaters and of the glycol/methanol injection pumps is to prevent the formation of hydrates in the equipment and in the pipelines that go from the well head to the treatment station.

The definitive treatment plants are:

- Absorption dehydration plants (glycol plants);
- Low Temperature Separation (LTS) dehydration plants;
- Solid bed treatment plants.

The treatment plants currently installed in the stations of the Storage Company are glycol plants. In these gas dehydration plants, triethylene glycol is used. Absorption of the water associated with the gas is achieved through the simple physical contact between the humid gas and glycol; the water-saturated glycol is then recovered and sent to a regeneration loop for subsequent reutilisation in the dehydration process.

2.2.4.2. *Compression stations*

During the withdrawal phase, both conventional and semi-conventional storage need compression only towards the final phase of the cycle because the reservoir pressure remains, on average, above the pressure of the RNG to which they are interconnected (free flow). The quantity of operational working gas that can be extracted without need for compression depends on the production mechanism and on the value of pressure reached at the end of the filling.

2.2.4.2.1. Description of the compression station

The compression station is interposed between the RNG and the gas pipeline connecting the station with the storage wells (flow line). Connection of the station with the RNG and the flow line is achieved with pipelines appropriately dimensioned to contain head losses and limit the noise generated by the transiting gas. The pipelines are called “intake and delivery manifold”, depending on the direction of the gas and of the inlet and outlet from the compressor.

The compression station generally consists of several modular units that are mutually connected by the placement of appropriate valves on each manifold. The valve allow the configuration of different types of operation, different functioning conditions and maintenance operations on the units, without compromising the overall operation of the station.
The compression station consists of the compression unit (which can be more than one) equipped with power supply, refrigeration, flow rate control/regulation systems.

2.2.4.2.2. Dimensioning of the compression stations

The main function of the compression station in the Storage sites is to make it possible to inject volumes of gas into the reservoir, drawn from the RNG at a lower pressure level than in the reservoir.
Compression can also be useful during the withdrawal phase, generally towards the end, when reservoir pressures tend to approach the values of the transport network. Use of compression during this phase, however, remains marginal.
The injection cycle is thus normally more constraining when dimensioning the compressors.
Therefore, dimensioning is based on the daily flow rates and intake pressures (pressure reached by the Gas from the RNG) and delivery pressures at which the compressor has to operate, taking into account the maximum limits of instantaneous delivery pressure applicable to avoid damaging the reservoir and the cap rocks.

2.2.4.2.3. Type of compressors

Compressors are divided into two classes:

- Reciprocating compressors
- Centrifugal compressors

Reciprocating compressors are included among machines called positive displacement compressors because they reduce the volume available to the fluid to increase its pressure.
There are various types of reciprocating compressors: horizontal, vertical, “V”.
In addition, in reciprocating compressors, cylinders can be double-acting and single-acting.
Centrifugal compressors, instead, transform the kinetic energy of the fluid into pressure energy.

Compressors are coupled to motors that enable the movement of their mechanical components. The motors can be electrically powered (with fixed rpm or with an rpm variator) or gas powered.

The compressors used by the Storage Company are reciprocating and powered by electric motors.

2.2.4.2.4. Configuration criteria of the compression stations

For the configuration of a compression station, numerous parameters are taken into consideration, including the level of flexibility the system must allow, the energy efficiency of the machine, and the level of investment, which play a fundamental role.
For the typical flow rates of the sites of the Storage Company, reciprocating compressors generally allow to best fulfil the flexibility requirements while retaining higher efficiency levels than centrifugal compressors.

2.2.4.2.5. Compression monitoring and control systems

The management of storage sites requires a certain flexibility in terms of daily peak performance, both due to purely commercial considerations, and because of constraints deriving from the characteristics of the reservoir.

The range of withdrawal and injection flow rates is a function of the filling of the reservoir and of the instantaneous operating pressures and it can be very broad; therefore, the need to regulate the pressure and flow rate parameters at the outlet of the compressor is an essential factor. When possible, it is preferable to carry out the adjustments by changing the rotation speed of the drive shaft coupled to the compressor. This takes place, for example, when the compressor is coupled to gas combustion engines (the fuel charge is changed) or to electric motors with variable rpm.

If the motor rotates at fixed rpm, the adjustment is carried out by recycling. There are also other possible adjustments, but tied to the type of compressor and to its construction elements; in reciprocating compressor, it can be effected with the change of the harmful space of the compression chambers, the exclusion of the effects, the engage-disengage system (not recommended because of the impact it can have on the machines and instrumentation).

2.3 DISPATCHING AND MANAGEMENT

Dispatching is a fundamental element of the System because it represents the operational, control and supervision centre for:

- Protecting the safety of the process;
- The performance provided by the Storage System;
- The execution of specific activities tied to the service itself.

Dispatching uses dedicated software which enables to minimise the checks and manipulations the operator has to carry out on the individual parts of the storage plant.

In particular, computerised management systems are used for the following activities:

1. Control of production and of the treatment and compression processes;
2. Production optimisation;
3. Management of commercial problems.

2.3.1 Control of production and of the treatment and compression processes

The activity allows to:

a. Monitor at all times the operation of the plants and the field instrumentation, assuring the safety of the equipment, of persons and of the environment at all times;
b. Remotely manage the stations in conditions of total or partial absence of overseeing personnel, significantly reducing operating costs and making production control more effective and dynamic;
c. Centralise production management and planning, improving the times required to respond to multiple market demands.

2.3.2 Optimisation of production

The activity allows to:

a. Optimally use the different properties of each site, also in light of the surface constraints, in order to determine significant performance increases for equal volumes moved by the storage system;
b. Optimally use each level of the site according to its own petrophysical characteristics and to the production mechanism;
c. Determine the daily flow rate of each well at all times, taking into account is location, the type of completion, the emptying/filling achieved.

The injection and withdrawal capacities are optimised allocating the total demand on the different storage reservoirs (basic and peak storage sites) that comprise the System, taking into consideration the constraints on the treatment/compression plants and on the RNG.

As mentioned above, storage sites are divided into two broad categories:

- Basic storage sites;
- Peak storage sites.

A brief description of the two types of storage is provided below.

2.3.2.1. *Basic storage sites*

These are used throughout the winter season and they generally are storage sites with high operational working gas and a slow decline of the daily peak capacity during the withdrawal phase.
This category includes most of the storage sites in depleted gas reservoirs and a certain part of storage sites in aquifers.

2.3.2.2. *Peak storage sites*

These are used only for short periods of time during the winter season to address daily demand peaks; the number of days of use can range from a minimum of 15-20 days to a maximum of 40-50 days depending on their dimensions.
The operational working gas is generally less than 0.5 Gmc and the decline in the daily peak during withdrawal is quite marked.
This category includes most of the storage sites in salt caverns and a certain part of storage sites in depleted gas reservoirs and in aquifers.

The reservoirs through which the Storage Company performs the storage activity, in view of their properties and development level, belong to the category of basic storage sites.

The allocation of total demand in the different storage reservoirs comprising the System is carried out optimising the properties of each of them and taking into consideration any constraints on the treatment/ compression plants and on the RNG.
This method of utilisation and management of the Storage Systems allows to identify the optimal withdrawal/injection profile of each reservoir, with the goal of assuring the best possible performance to the System.
In other words, the method allows both to maximise the peak availability of the System for equal volume extracted, and to assure filling within the times prescribed for the injection phase and with the suitable levels of flexibility.
The optimisation input data consist of the withdrawability/injectability curves of all the sites that comprise the Storage System in question and of the loading curve the System must follow.

2.3.3 Management of commercial problems

The activity allows to:

- Manage the reservation, assignment and reassignment processes;
- Manage the processes for the allocation of the gas moved from storage;
- Manage the invoicing processes.

The Storage Company has developed an Electronic System (hereafter also Escomas) to make available the functionalities set out below in an impartial and non discriminatory manner and to optimise, in terms of effectiveness and efficiency, the management of the following processes:

- Storage capacity assignments at the start and in the course of the Thermal Year;
- Availability of performance and scheduling;

- Allocations;
- Storage position in terms of stock;
- Capacity and Gas transactions;
- Balancing and replenishment of the storage sites;
- Invoicing;
- Communications between Storage Company and Shipper, when provided;
- Other functionalities and information.

This system, and its functionalities, shall be better described in the following paragraphs and chapters and in the Escomas utilisation manual.

2.4 DETERMINATION OF AVAILABLE CAPACITIES

The determination of the minimum guaranteeable performance and then, daily, the allocation of total demand in the different storage reservoirs comprising the System is carried out optimising the properties of each of them (basic and peak storage), taking into consideration any constraints on the treatment/ compression plants and on the transport system and the schedule of the works for the regulation, enhancement and development of the System.

This method of utilisation and management of the storage systems allows to identify the optimal withdrawal/injection profile of each reservoir, with the goal of assuring the best possible performance to the System.

In other words, the method allows both to maximise the peak availability of the System for equal volume extracted, and to assure filling within the times prescribed for the injection phase.

The optimisation input data consist of the withdrawability/injectability curves of all the sites that comprise the Storage System in question and of the loading curve the System must follow; for the sake of completeness, it should be recalled that the loading curve is merely the quantity of gas that the set of the sites to be optimise must satisfy and that the withdrawability/injectability curves are rendered through the three functions:

- Qg = daily flow rate as a function of emptying/filling
- S = emptying/filling as a function of time
- P = pressure as a function of emptying/filling

The movement and transfer of the gas volumes between the transport system and the underground storage reservoirs takes place through the natural gas storage station. During the development or enhancement phases of a storage

site, the facilities of the storage station (flow lines, treatment and compression system) can constitute a constraint in the determination of the maximum performance the Site can provide.

During operational management, the configuration and type of surface facilities can represent limits to the flexibility of the Storage System (flow reversal, minimum withdrawable flow rates).

All equipment contained in the stations are dimensioned for the purpose of carrying out a complete storage cycle taking into consideration the maximum performance obtainable from the reservoir. The cycle comprises an injection (or storage) operational phase and a withdrawal (or production) operational phase in which the volumes stored in the previous phase are redelivered to the system from which they were drawn.

Therefore, the determination of the storage Capacity is based on:

- Mining aspects;
- Technical-managerial aspects.

The following paragraphs describe the procedures whereby the storage Capacities are defined.
The aforesaid capacities can be subject to changes over time inasmuch as they depend on the actual filling and emptying at the end of the injection and withdrawal campaign, on the technical-managerial conditions of the transport system connected to the plant and on the work schedules for work on the System.

2.4.1 Mining aspects

Storage capacity depends, in the first place, on the geometry of the reservoir and on its geophysical characteristics, which are identified through the following activities:

a. Geological survey of the identified structure and of the cap rocks;
b. Study of the behaviour during the production phase, in the case of depleted or semi-depleted gas reservoirs (conventional storage);
c. Dynamic simulation of the behaviour of the structure in the injection and withdrawal phase through the use of specifically devised mathematical models;
d. Determination of the performance with filling both at the original pressure and at a higher pressure than the original one, assuming different values of dynamic pressure at the well head;

e. Determination of the performance according to the number and type of the wells (vertical, horizontal wells) and of the type of completion (completion with gravel pack, with large-diameter tubing, etc.).

In the case of depleted or semi-depleted gas reservoirs, the surveys per points a) and b) have already been carried out and revised in the course of the productive life of the reservoir; in particular, the analysis of the dynamic behaviour conducted during the primary production phase enables to identify the characteristic parameters of the reservoir-aquifer system (production mechanism with simple expansion, moderate water thrust, strong water thrust) which are at the base of dimensioning in terms of capacity and productivity of future storage.

The simulations, which we have briefly mentioned, allow to determine the technical performance achievable and the other storage parameters (Working Gas, withdrawal/injection peak, Cushion Gas), as reservoir pressure and well head dynamic pressure change.

2.4.2 Technical-managerial aspects

In addition to the mining aspects, the storage Capacity also depends on some technical-managerial parameters:

a) *Schedule of Significant Works*: the performance made available by the Storage Company are strongly influenced by the schedule of Significant Works, as defined in paragraph 13.2 of the chapter “Scheduling and Managing Maintenance Operations” and notified to the MSE in accordance with the Bill. A change in the timelines or type of work can modify the availabilities of the system for a value exceeding 40% of the available performance.

b) *Delivery/Redelivery Pressures*: the compression station serves the purpose of raising the pressure of the gas coming from the RNG to such values as to allow its injection into the reservoir during the filling (injection) phase or, vice versa, its placement in the RNG during the reservoir emptying phase (withdrawal). The operating pressures of the storage reservoirs change considerably according to the level of filling and are, on average, higher than the operating values of the primary network of gas pipelines; therefore, the minimum guaranteed level of pressure, especially in the injection phase, represents an extremely significant managerial constraint to assure the guarantee of the Performance.

c) *The characteristic trend of the User’s modulation needs*;

d) *Reversibility of the flow*: to perform the physical Reverse Flow service, illustrated in sub-paragraph 3.2.2.1, the Storage Company must carry out the following activities:

- Modify the set-up of the station (compressor start-up/shut-down, opening/closing valves, activating/deactivating the dehydration system, etc.);
- Change the set-up of the well areas (opening/closing valves, inserting/excluding separators, heaters, regulating valves, etc.);
- Reverse the technical and fiscal measurements present both in the station and at the well areas;
- Request the connected Transport Company to reverse the corresponding measurement station;
- Inform, via fax, the Ministry of Economic Development, UNMIG Division, of all the operations indicated above, indicating the measurement lines in operation.

Therefore, as indicated in chapter 6 “Injection and withdrawal reservations and commitments”, the Shipper may request solely the virtual reverse flow service because it is not possible to carry out the aforesaid actions in a time interval compatible with the hourly renominations.

e) *The schedule of periodic tests and of the other scheduled works*: any type of work requiring the interruption of activities on part of the System, obviously has impacts on the available performance.

2.4.3 Determination of the System’s Performance

Considering the description already provided in this chapter, the Storage Company simulates the dynamic behaviour of its own storage reservoirs and of the performance associated with it through the use of dedicated calculation instruments and software.
The simulations conducted have the goal of optimising the performance offered in the Injection and Withdrawal Phases in compliance with the rules issued by the MSE and with the measures of the Authority taking into account the petrophysical parameters and the production history of each storage reservoir.

2.4.3.1. *Simulation tools*

The Storage Company, within the scope of its activity for the development of its own reservoirs that are not yet regulated, is developing the models for the simulation of the dynamic behaviour of the storage reservoirs and the physical quantities associated with them (injected/withdrawn volumes, static and dynamic pressure, storage capacity in terms of Space, the Injection and Withdrawal availability over time, etc.). It currently simulates the behaviour of its own sites both by means of an “Eclipse” 3D mathematical simulator

(normally used in the petroleum industry) and by means of models developed ad hoc. These models, which are based on the geodynamic and structural information acquired over time and on the production history of the reservoirs both in the primary production and in the storage phase, are constantly updated and recalibrated.

In particular, all static and dynamic models reflect the characteristic geodynamic, physical and petrophysical parameters of each reservoir. It is stressed that the dynamic behaviour of a reservoir in fact is neither linear nor stationary and therefore the reservoir, to be operated without risk of possible damages, needs an accurate definition of its model.
In the case of storage sites not yet regulated and hence subject to continuous equipment changes and for which new wells are being constructed, it is evident that the simulation models are based mainly on information collected during the production phase and hence do not yet have within them any information on the behaviour of the new wells and of the reservoir in the new conditions.

2.4.3.2. *Technical and managerial constraints and input data for the simulations*

The Space values and the peak Injection and Withdrawal availabilities, relating to the individual reservoirs, are determined starting from the aforesaid simulations respecting the constraints of the reservoir, of the well, of the technical surface equipment.
The simulation necessary to determine the performance are carried out considering distinct input data for the injection and withdrawal Phase, subject to the constraints of each storage reservoir, depending on the production history, e.g. the state of the wells, their location with respect to the hydrocarbon-bearing area, their type of completion and the stoppages or modulations that involve the injection and/or withdrawal phase due to the enhancement or development works.

The inputs considered for the simulations relating to the Injection Phase are:

- The maximum reservoir static pressure not to be exceeded, which is equal to the original static pressure or to the different value authorised by the MSE for the individual storage reservoir in the case of regulated reservoirs;
  For reservoirs undergoing enhancement and not yet regulated, the pressure considered in the simulations is the one expected to be reached with the volume deemed to be injectable, taking into account the enhancement works and/or the constraints existing on the current surface facilities.
  The injectable volume and the associated pressure are therefore determined iteratively imposing the constraint that it must be possible to

withdraw, during the withdrawal phase, the gas injected by the Users during the previous injection phase.

- The maximum receptive capacity of each well in the course of the injection phase;
- The maximum receptive capacity of each reservoir in the course of the injection phase, which depends on the characteristics of the reservoir and on the operating limits of the compression plants;
- The shutdowns that become necessary for the measurement of the background static pressure at the end of the injection phase, as provided by article 18 of Ministerial Decree 26/8/05, and those that may be scheduled in the course of the cycle. The latter shutdowns are particularly important especially in the enhancement and development phase of a reservoir when it becomes necessary to monitor the progress of the reconstitution;
- The schedule of the works authorised by the MSE for the execution of the Significant Works;
- The operating time of the Injection Phase, which must be approximately 6/7 months.

The inputs considered for the simulations relating to the Withdrawal Phase are:

- The maximum withdrawal capacity of each well;
- The maximum capacity of each reservoir in the course of the withdrawal phase, which depends on the characteristics of the reservoir and on the maximum operating limits of the surface facilities;
- The minimum withdrawal performance, generally coinciding with the minimum limit of the treatment and compression stations;
- The minimum values of the well head dynamic pressure;
- The maximum quantity of water producible on a daily and annual basis, in compliance with the volumes to be re-injected in levels located underground;
- The shutdowns that become necessary for the measurement of the background static pressure at the end of the withdrawal phase, as prescribed by article 18 of Ministerial Decree 26/08/05, and those that may be scheduled in the course of the cycle. The latter shutdowns are particularly important especially in the enhancement and development phase of a reservoir when it becomes necessary to monitor the progress of the withdrawal;

- The schedule of the works authorised by the MSE for the execution of the Significant Works;
- The operating times, of approximately 5/6 months.

The injectability and withdrawability curves of the models of each site are the basis for determining the capacities made available in the assignment phase.

2.4.3.3. *Results of the simulations*

The results of the simulations as per the previous paragraph consist of the injectability and withdrawability curves of the Storage System which associate the volumes moved to the peak availabilities.

- Relations between Space and Injection (injectability curves): optimal Injection profile and availability of Injection peak

The optimal Injection profile is initially defined in the month of January - taking into account the best forecasts for the evolution of the total withdrawal until the end of the Thermal Year and the technical and managerial constraints per paragraph 2.4.2. - on the basis of the following operating concepts:

- Injection of high volumes in the initial phase, compatibly with existing plants.
- Optimisation of the injection flow rates following the initial phase, according to the actual capacities of the reservoirs and of the plants in order to maximise the injection availability.

Based on these considerations, the optimal filling conditions are defined as well as the consequent trend of the peak Injection availability, an inverse function of the cumulative injected volume.

The decreasing trend of that availability over time has the purpose of driving the injection of the monthly volumes according to the real capacities of the reservoirs without causing overpressure phenomena, which would consequently entail a subsequent reduction of the volumes to be injected.
To take into adequate consideration the operational flexibilities required by the Users of the System and the fact that the optimal profile may not be followed precisely, minimum and maximum alternative progressive profiles are also verified, which still assure a correct overall filling of the reservoirs.

- Relations between Space and Withdrawal (withdrawability curves): optimal Withdrawal profile and availability of Withdrawal peak

The Withdrawal profile for the following Thermal Year is initially defined in the month of January, taking into account the complete filling of the assigned Space, the enhancement, regulation and development works, the technical and managerial constraints per point a), with the goal of maximising the space and the withdrawal flow rate made available to Users.

The Withdrawal profile is determined on the basis of the following criteria:

- Maintaining the maximum withdrawal capacity available over time;
- Withdrawing high volumes in the period of highest climatic demand (between January and February);
- Optimising the withdrawal flow rates, according to the actual capacities of the reservoirs in order to maximise the withdrawal availability of the Storage System;
- Maximising the operational working gas made available to the Shippers.

The Storage Company determines the utilisation profiles and the withdrawal adjustment factors consistent with the trend of the optimised performance curve of the System and can offer additional Withdrawal performance to the Shippers, on a continuous or interruptible basis taking into account the need to preserve the continuity of the optimised withdrawal performance until the end of the Withdrawal Phase.

- Determination of the Space, of the Injection Flow Rate (PI) and of the Withdrawal Flow Rate (PE)

Starting from the results of the simulations, the Storage Company determines the capacities available for the mandatory services, per chapter 3 “Description of the services” below, in terms of Space, Injection Performance and Withdrawal Performance.

Space or S

The total space made available for assignment is defined on the basis of the injectability and withdrawability curves of the System, as well as of the assignment forecast for the different types of services (Strategic, operational balancing, Hydrocarbon and modulation).
Since each service is associated with a different Withdrawal and Injection Performance, a change with respect to the assignment assumptions formulated in terms of allocation of the available capacities in the different types of service, changes the total volume made available.
By way of example, an incremental space assigned for the hydrocarbon storage service does not simply reduce the space assignable for the modulation service, but it reduces the total assignable space.

It is thus evident that if the requests for the storage services with higher assignment priority are different from the assumed ones, the Storage Company shall recalculate and publish again the capacity data S, PI and PE available before the end of the assignment cycle.
For the purpose of the offer of the mandatory services, the Storage Company makes available to Shippers a Space capacity, divided according to the following categories of services:

a. Space for strategic storage (S_{STR});
b. Space for the operational balancing of the system (S_{BIL});
c. Space for the hydrocarbon storage service (S_M);
d. Space for the modulation storage service (S_{MOD}).

If additional Space is found to be available in the course of the Thermal Year, it will be assigned, as primary capacity, on a monthly, weekly and daily basis within the competitive procedures per paragraph 5.9.2 for the Modulation Service on a monthly, weekly, daily basis per paragraph 3.2.5.

Injection Flow Rate or PI

The total PI made available for assignment is defined on the basis of the technical capacity of the system and, during the Injection Phase, it has a declining trend as a function of progressive filling, while in the withdrawal phase it is made available according to the characteristics of its own storage system and to the procedures expressed in sub-paragraph 3.2.2.1 of the chapter “Description of the services”.

For the purpose of the offer of the mandatory services, the Storage Company makes available for assignment a capacity CI equal to the value of the PI available at the start of the injection phase and is divided according to the following categories of services:

a. Injection Flow Rate for the operational balancing of the system (CI_{BIL});
b. Injection Flow Rate for the hydrocarbon storage service (CI_M);
c. Injection Flow Rate for the modulation storage services and for the purposes of replenishing the strategic storage (CI_{MOD}).

If additional Injection capacity is found to be available in the course of the Thermal Year, it will be assigned to the shippers modifying the utilisation coefficients or, if it is capacity not sold in the course of the assignment procedures on an annual and infra-annual basis per paragraph 5.8.2.4 and paragraph 5.9.1, as primary capacity, on a monthly, weekly and daily basis within the competitive procedures per paragraph 5.9.2 for the Modulation Service on a monthly, weekly, daily basis per paragraph 3.2.5.

Withdrawal Flow Rate or PE

The total Withdrawal Flow Rate made available for assignment is determined on the basis of the technical characteristics of the system and it has a declining trend as a function of the total emptying of the system.
For the purpose of the offer of the mandatory services, the Storage Company makes available for assignment a capacity CE equal to the value of the PE available at the end of the emptying of the modulation and hydrocarbon Working Gas and it is divided according to the following categories of services:

a. Withdrawal Flow Rate for the operational balancing storage service (CE_{BIL});
b. Withdrawal Flow Rate for the hydrocarbon storage service (CE_{M});
c. Withdrawal Flow Rate for the modulation storage service (CE_{MOD}).

If additional Withdrawal capacity is found to be available in the course of the Thermal Year, it will be assigned to the shippers modifying the utilisation coefficients, according to the procedures described in paragraph 3.2.2.3, or, if it is capacity not sold in the course of the assignment procedures on an annual and infra-annual basis per paragraphs 5.8.2.4 and 5.9.1, as primary capacity, on a monthly, weekly and daily basis within the competitive procedures per paragraph 5.9.2 for the Modulation Service on a monthly, weekly, daily basis per paragraph 3.2.5. In particular, the withdrawal capacity in the injection phase shall be sold in these competitive procedures.

2.4.4 From the performance of the System to the available Capacities

2.4.4.1. *Capacity for the Strategic Storage Service*

The Storage Service determines the Space available for the Strategic Storage Service (hereafter S_{STR}) in a proportion equal to that under its own responsibility, deriving from the allocation carried out among the storage companies, with respect to the total quantity established by the MSE.

2.4.4.2. *Capacity for the operational Balancing Service for transport companies*

The Storage Company determines the Capacity for the operational Balancing Service of the transport companies in the following way:

- The Space (hereafter S_{BIL}) is equal to the total quantity requested by the Transport Company;
- The Injection Flow Rate (hereafter CI_{BIL}) is equal to the total quantity requested for balancing needs by the Transport Company;

- The Withdrawal Flow Rate (hereafter CE_{BIL}) is equal to the total quantity requested for balancing needs by the Transport Company.

2.4.4.3. *Available capacity for the Hydrocarbon Storage Service*

The Storage Company determines the Capacities for the Hydrocarbon Storage Service in the following way:

- The Space (S_M) is equal to the lower value between the quantity assigned by the Storage Company in the previous Thermal Year and the quantity authorised by the MSE;
- The Injection Flow Rate (CI_M) is equal to S_M divided by 170 (one hundred seventy) days, consistently with the objective of assuring to national production a flexibility of supply that is comparable to the characteristic one of import contracts; 170 is the number of days obtained by applying to the Injection Period the same flexibility prescribed for the Withdrawal Period;
- The Withdrawal Flow Rate (hereafter, CE_M) is equal to the lower value between the quantity assigned by the Storage Company in the previous Thermal Year and the quantity authorised by the MSE.

Where

$$CE_M = CE_{Mbase} + CE_{Mbackup}$$

and

$$CE_{Mbase} = S_M/120$$

2.4.4.4. *Capacity for the Modulation Service*

The Storage Company determines the Capacities for the Modulation Service in the following way:

- The Space (hereafter S_{MOD}) is equal to:

$$S_{MOD} = S - S_{STR} - S_M - S_{BIL}$$

where S is equal to the total Space made available and possibly revised for assignment in accordance with paragraph 2.4.2.3 above;

The Modulation Service S_{MOD} comprises the Peak Modulation service and the Uniform Modulation Service, which are differentiated by the Withdrawal Capacity associated with them.

$S_{MOD=} S_{MODP} + S_{MODU}$

Where:

S_{MODP} is the Space offered for the Seasonal Peak Modulation Service;

S_{MODU} is the Space offered for the Uniform Modulation Service.

The determination of the division of S_{MOD} is established by the Ministry of Economic Development.
In accordance with the Ministry of Economic Development Decree in force at the time of the assignment at the start of the thermal year, Edison Stoccaggio does not assign capacity for the Uniform Modulation Service.

The Space S_{MODP} in turn is divided into

$S_{MODP} = S_{MODPS} + S_{MODPM}$

and similarly

The Space S_{MODU} in turn is divided into

$S_{MODU} = S_{MODUS} + S_{MODUM}$

Where:

S_{MODPS} = Space for the Seasonal Peak Modulation Service

S_{MODPM} = Space for the Monthly Peak Modulation Service

S_{MODUS} = Space for the Seasonal Uniform Modulation Service

S_{MODUM} = Space for the Monthly Uniform Modulation Service

The seasonal services entail the availability of Injection Capacity in the period between the month following the one when Capacities are assigned and the month of October.

The monthly services entail the availability of Injection Capacity solely in the month following the one when Capacities are assigned.

The Capacities for the Peak Modulation Service are made available, no later than the month of March, for assignment at the start of the thermal year and they offered on a priority basis for the Seasonal Peak Modulation Service, according to the assignment procedures on an annual basis per paragraph 5.8.2.4.

If there are unassigned quantities at the end of the aforesaid assigned process, Edison Stoccaggio shall define the quantities assignable for the Peak Modulation service with injection in the month of April and, if additional capacities are available, Edison Stoccaggio will make these quantities available through assignments after the start of the Thermal Year with competitive procedures (procedures for the assignment of capacity on an infra-annual basis per paragraph 5.9.1) distinct for the Seasonal and Monthly Peak Modulation Service.

The quantities of Space for the monthly products are determined iteratively after the outcomes of the assignment of the seasonal products and according to the unassigned injection capacity available for the month of the assignment. By way of example, if capacity remains following the procedure for the assignment of the seasonal product of the Seasonal Peak Modulation Service starting on 1 April, the Space offered for the monthly product of the month of April shall be determined as the lower value between the unassigned Space available for the Seasonal Peak Modulation Service and the maximum quantity injectable in the month of April alone.

Consequently, if capacity remains following the assignment procedures of the month m-1 of the seasonal product and of the monthly product starting in the month m, Edison Stoccaggio, iterating the process described above, shall make available in the month m:

- for the seasonal product, the Space corresponding to the total injectable quantity from the month m+1 until the end of the Injection Phase;
- for the monthly product, the Space corresponding to the maximum quantity injectable in the month m+1 alone.

The Injection Flow Rate (hereafter CI_{MOD}) is equal to:

$$CI_{MOD} = CI - CI_{M} - CI_{BIL}$$

where CI is equal to the total Injection Flow Rate made available and possibly revised for assignment in accordance with paragraph 2.4.2.3 above;

The Injection Capacity for the Modulation Service CI_{MOD} is divided into a portion intended for the peak modulation service and one intended for the uniform modulation space.

$CI_{MOD=} CI_{MODP} + CI_{MODU}$

Where:

CI_{MODP} is the Injection Capacity offered for the Seasonal Peak Modulation Service;

CI_{MODU} is the Injection Capacity offered for the Seasonal Modulation Service.

The determination of the subdivision of CI_{MOD} is established by the Storage Company according to the following proportionality criterion:

$CI_{MODP} = CI_{MOD} \times S_{MODP}/S_{MOD}$

$CI_{MODU} = CI_{MOD} \times S_{MODU}/S_{MOD}$

The Injection Capacity for the Peak Modulation Service CI_{MODP} in turn is subdivided into

$CI_{MODP} = CI_{MODPS} + CI_{MODPM}$

and similarly

the Injection Capacity for the Uniform Modulation Service CI_{MODU} in turn is subdivided into

$CI_{MODU} = CI_{MODUS} + CI_{MODUM}$

Where:

CI_{MODPS} = Injection Capacity for the Seasonal Peak Modulation Service

CI_{MODPM} = Injection Capacity for the Monthly Peak Modulation Service

CI_{MODUS} = Injection Capacity for the Seasonal Uniform Modulation Service

CI_{MODUM} = Injection Capacity for the Monthly Uniform Modulation Service

The injection flow rate associated to the individual product of the Modulation Service shall be equal to:
$CI_{MODi,k} = CI_{MODi} \times S_{MODi,k}/S_{MODi}$

Where: i distinguishes the type of service, peak or uniform, and k the time reference of the assignment, seasonal or monthly product.

- The Withdrawal Flow Rate (hereafter CE_{MOD}) is equal to:

$$CE_{MOD} = CE - CE_M - CE_{BIL}$$

where CE is equal to the total Flow Rate made available and possibly revised for assignment in accordance with paragraph 2.4.2.3 above;

It is stressed that the CE_{MOD} for the modulation storage service can consist of a continuous component and possibly by an interruptible component.

The Withdrawal Capacity for the Modulation Service CE_{MOD} is divided into a portion intended for the peak modulation service and one intended for the uniform modulation space.

$CE_{MOD=} CE_{MODP} + CE_{MODU}$

The Uniform Modulation Service has associated to the assigned space S_{MODU} a constant withdrawal capacity equal to:

$CE_{MODU} = S_{MODU} / 150$

The Peak Modulation Service has associated a withdrawal capacity, variable according to the time and to the monthly withdrawable volumes, such as to assure the maximum performance availability in the months of January and February in accordance with the Ministry of Economic Development Decree in force at the time of the assignment at the start of the thermal year.

For the Peak Modulation Service, the utilisation profiles of the Withdrawal Capacity are annexed to the Ministerial Decree in force at the time of the assignment at the start of the thermal year.

In the course of the thermal year, the Storage Company organises the capacity assignment procedures on a monthly, weekly and daily basis per paragraph 5.9.2 for the Modulation storage Service on a monthly, weekly and daily basis.

2.4.4.5. *Capacity for the Modulation Service with assignment on a monthly, weekly and daily basis*

The Storage Company determines the Capacities for the Modulation Service on a monthly, weekly and daily basis and assigns them according to the procedures per paragraph 5.9.2. below, in the following way:

a) the Space made available on a monthly, weekly and daily basis ($S_{MOD,M}$, $S_{MOD,W}$, $S_{MOD,D}$) is determined on the basis of the Space capacities made available in the course of the Thermal Year, as well as on the basis of the quantity progressively available taking into account the quantity of Gas withdrawn or injected and the Shipper's monthly, weekly and daily schedules;

b) the Injection Capacity made available on a monthly, weekly and daily basis ($CI_{MOD,M}$, $CI_{MOD,W}$, $CI_{MOD,D}$) is equal:

- In the Withdrawal Period

  - To the continuous Injection Capacity on a monthly, weekly and daily basis in addition, if available, to the available Injection Capacity in the Withdrawal phase assigned at the start of the thermal year;
  - To any additional interruptible Injection Capacity in the withdrawal phase per the previous point unscheduled and unallocated in the first session as per paragraph 5.9.2 below

- In the Injection Period

  - To the continuous Injection Capacity on a monthly, weekly and daily basis in addition, if available, to the available Injection Capacity (CI_{MOD}) per paragraph 2.4.4.4 and with respect to the one assigned to the shippers through modification of the adjustment coefficients;
  - To the interruptible Injection Capacity on a monthly, weekly and daily basis per the previous point unscheduled and unallocated in the first session under paragraph 5.9.2 below.

c) the Withdrawal Capacity made available on a monthly, weekly and daily basis ($CI_{MOD,M}$, $CI_{MOD,W}$, $CI_{MOD,D}$) is equal:

- In the Withdrawal Period
  - On a monthly, weekly and daily basis additional with respect to the available Withdrawal Capacity (CE_{MOD}) per paragraph 2.4.4.4 and with respect to the one assigned to the shippers through modification of the adjustment coefficients per paragraph 2.4.4.9 and paragraph 3.2.2.3 below;
  - To the interruptible Withdrawal Capacity on a monthly, weekly and daily basis per the previous point unscheduled and unallocated in the first session as per paragraph 5.9.2 below.

- In the Injection Period
  - On a continuous monthly, weekly and daily basis, as Withdrawal capacity in the Injection phase per paragraph 2.4.4.7, assigned in accordance with the competitive procedures per paragraph 5.9.2;
  - To the interruptible Withdrawal Capacity on a monthly, weekly and daily basis per the previous point unscheduled and unallocated in the first session as per paragraph 5.9.2 below.

2.4.4.6. *Capacity for the Modulation Service with assignment on a daily basis according to the overnomination mechanism*

The Storage Company determines the Injection and Withdrawal Capacities for the Modulation Service (CI_O, CE_O) and assigns them according to the procedures per paragraph 3.2.2.2 below, as confirmed as a result of the procedures per paragraph 6.6.5.

2.4.4.7. *Capacity for the reverse flow Service*

Taking into account the indications provided in paragraph 2.4.2 and in paragraph 2.4.3.3, the storage company determines the Withdrawal Capacity in the injection phase and the Injection capacity in the withdrawal phase, on the basis of the technical capacities of the system to reverse its flow without limiting the performance available to the other Shippers.
However, upon establishing the need to reverse the flow as a result of the Shippers' scheduling and physically determining the set-up of the site, the Storage Company, in accordance with the criteria per paragraph 6.6.6, it does not allow, during the renomination cycle, any changes to the Shippers' scheduling for the same period which entails a further revision of the aforesaid set-up, allowing in fact only virtual flow reversals.

Capacities are made available and assigned in accordance with the procedures prescribed in the following chapters.

2.4.4.8. *Additional injection capacity*

If the peak injection availability already assigned in the course of the Injection Period shows an additional availability of continuous PI with respect to the availability per paragraph 2.4.4.4, the Storage Company makes available to Shippers an additional PI by modifying the adjustment coefficients, subject to the need to safeguard the correct utilisation of the reservoirs.

2.4.4.9. *Additional withdrawal capacity*

If the peak withdrawal availability already assigned in the course of the Withdrawal Period shows an additional availability of continuous PE with respect to the availability per paragraph 2.4.4., the Storage Company makes available to Shippers an additional PE in accordance with the procedures set out in paragraph 3.2.2.3, subject to the need to safeguard the System.

2.4.4.10. *Interruptible capacity*

If, both in the Injection Period and in the Withdrawal Period, residual capacities become available in addition to the continuous capacities scheduled by the Shippers or allocated following the procedures per the following paragraph 5.9.2 on a monthly, weekly and daily basis, first session, the Storage Company offers such capacities on an interruptible basis, per paragraph 3.2.5.2 below, within the competitive procedures per paragraph 5.9.2, second session and, only on a daily basis, within the overnomination mechanism per paragraph 3.2.2.2.

2.4.5 Utilisation Profiles and adjustment coefficients of the PI and PE Performance

As pointed out in the previous paragraph, the dynamic evolution of the PE and of the PI depends mainly on the following factors:

- Behaviour of the reservoirs, of the wells;
- Technical characteristics of the plants;
- Technical-managerial constraints;
- The schedule of Maintenance Operations.

To optimise the System while assuring the maximum flexibility to Shippers, the Storage Company defines, for the Performance of the Modulation service:

i. Utilisation profile and adjustment coefficients of the storage Capacity in the injection phase and related range of applicability;
ii. Utilisation profile and adjustment coefficients of the storage Capacity in the withdrawal phase and related range of applicability.

The Storage Company does not define utilisation profiles and/or adjustment factors for the operational balancing service, taking into account its different operating procedures and functionalities, whereas it defines, exclusively for the injection phase, the utilisation profiles for the hydrocarbon storage service, to assure the complete filling of the assigned space.

2.4.5.1. *Utilisation profile for the injection phase for the hydrocarbon storage service*

Utilisation profiles are defined taking into account the need to fill the assigned space and the procedures for the assignment and allocation of the PI_M.

2.4.5.2. *Utilisation profiles, adjustment coefficients of the storage Capacity and related range of applicability in the injection phase for the modulation storage service*

The storage company defines the utilisation profile and the adjustment coefficients of the storage capacity, for the injection phase, in relation to the characteristics of its own storage system, to the schedules for periodic tests and to the need to reconstitute the reservoirs assuring appropriate flexibility to shippers.
These parameters are obtained assuming the complete emptying of the S_{MOD} and based on the following criteria:

- Trend of the historical amount injected in the previous thermal Year
- Actual emptying of the previous thermal year
- Volume to be injected in order to assure the reconstitution of the reservoir comprehensive of any strategic storage volume;
- Maximisation of the injection capacity in the periods of greatest need for Shippers, in compliance with the technical constraints;
- Assurance of the filling of the assigned space.

The utilisation profile defines the minimum and maximum stock allowed to the Shipper at the end of each month of the injection phase, in relation to the capacity assigned to the shipper. They are represented by percentages (Gmin% and Gmax%) which, multiplied times the assigned Space determine

the range of stock values within which the Shipper's stock must be at the end of each month.

The adjustment coefficients and the related ranges of applicability, instead, represent the multiplicative factors to be applied to the assigned CI_{MOD} to determine the maximum available Injection Performance (PI_{MOD}) of the system on each day of the service.
The adjustment coefficients are such as to reflect the declining trend of the PI_{MOD} as a function of the total filling, and any Performance reductions consequent to Significant Works.

The Injection Performance associated with the injection capacity of each Shipper k for the modulation Service is determined on the basis of the ratio R_u applied to the overall performance of the system, determined as follows:

$$Ru_k = \frac{\max(G_{max\ u,k} - G_{i\ u,k};\ 0)}{G_{max\ s,k} - G_{min\ s,k}}$$

where:

- $G_{max\ u,k}$ is the maximum stock of the Shipper u at the end of the month k of the injection phase determined on the basis of the provisions of paragraph 8.4.2 below;
- $G_{i\ u,k}$ is the greater value between the minimum stock, determined on the basis of the provisions of paragraph 8.4.1 below, and the actual stock of the Shipper u at the start of the month k of the injection phase;
- $G_{max\ s,k}$ is the maximum stock envisioned in relation to the set of the capacities available to the shippers, on the basis of their utilisation profiles, at the end of the month k;
- $G_{min\ s,k}$ is the minimum stock envisioned in relation to the set of the capacities available to the shippers at the start of the month k, on the basis of their utilisation profiles.

For the purposes of determining the term $G_{i\ u,k}$ for the month of April, the minimum stock on the basis of the provisions of paragraph 8.4.1 below shall take into account the actual stock of the system as at 31 March.

If capacity is assigned to a Shipper u in a month k within the different allocation procedures of products with seasonal or monthly injection, the terms $G_{max\ u,k}$ and $G_{i\ u,k}$ are determined on the basis of the maximum and minimum stock referred to the capacities assigned in the different procedures.

Any available performance exceeding those attributed to the set of shippers as determined above are attributed to shippers pro rata on the basis of the Ru ratio.

Therefore, the allocation in favour of each shipper of any injection capacities of the system in excess to the set of the capacities attributed to each individual shipper through the parameter Ru is carried out on the first day of each month of the injection phase with a pro-rata criterion on the basis of the individual Ru ratios.

$PI_{MODk}=PI_{MOD}*Ru_k$.

If the residual Space of the Shipper is smaller than the available Injection Capacity, then the Injection Capacity shall be equal to the residual Space.

The total available Injection Capacity is equal to the product of the total Injection Capacity assigned for the Modulation Service and the Adjustment Coefficient. The latter is the coefficient, between zero and one, variable as an inverse function of the total System stock, as published and updated by the Storage Company on its own website.

The utilisation profiles, the filling ranges and the corresponding adjustment coefficients are published on the Website of the Storage Company and updated according to the procedures prescribed by paragraph 2.4.6 below.

If the User of the Modulation service has sold injection performance within the procedures per paragraph 5.9.2, the sold portion will be subtracted from its daily Injection Performance.

2.4.5.3. *Utilisation profiles, adjustment coefficients of the storage Capacity and related range of applicability in the injection phase for the Modulation service with assignment of capacity on a monthly, weekly and daily basis.*

The Injection Capacity assigned within the procedures per paragraph 5.9.2 does not undergo changes in relation to the progress of the Shipper's Injection or Withdrawal.

It is also understood that this capacity is equal to zero in case of complete filling of the Space available for the Shipper and the balancing prices as per chapter 8 below apply for all quantities injected beyond the available Space.

2.4.5.4. *Utilisation profiles, adjustment coefficients of the storage Capacity and related range of applicability in the Withdrawal phase for the modulation storage service.*

The storage company defines the utilisation profile and the adjustment coefficients of the storage capacity, for the withdrawal phase, in relation to the characteristics of its own storage system assuring appropriate flexibility to the shipper.
These parameters are determined if the assigned Space is completely filled and on the basis of the following criteria:

- Maintaining the maximum withdrawal capacity available as long as possible through hydrocarbon optimisation;
- Guarantee of the maximum continuity of the available performance;
- Complete emptying of the assigned Space, with the exclusion of the S_{STR};
- No change to the schedule of Significant Works.

The utilisation profile defines the minimum stock allowed to the Shipper at the end of each month, in relation to the assigned S_{MOD}.

The adjustment coefficients and the related ranges of applicability, instead, represent the multiplicative factors to be applied to the assigned CE_{MOD} to determine the maximum Withdrawal Performance (PE_{MOD}) available to the Shipper on each day of the period of validity of the assigned capacity.
The adjustment coefficients are such as to reflect the declining trend of the PE_{MOD} as a function of the total emptying and of each Shipper's emptying, and any Performance reductions consequent to Significant Works.
The utilisation profiles, the filling ranges and the corresponding adjustment coefficients are published on the Website of the Storage Company and updated according to the procedures prescribed by paragraph 2.4.6 below.

If the User of the Modulation service has sold withdrawal performance within the procedures per paragraph 5.9.2, the sold portion will be subtracted from its daily Withdrawal Performance.

2.4.5.5. *Utilisation profiles, adjustment coefficients of the storage Capacity and related range of applicability in the Withdrawal phase for the Modulation service with assignment of capacity on a monthly, weekly and daily basis.*

The Withdrawal Capacity assigned within the procedures per paragraph 5.9.2 on a continuous and interruptible basis does not undergo changes in relation to the progress of the Shipper's Withdrawal or Injection.

This capacity is equal to zero in case of complete utilisation of the Gas owned by the Shipper. In addition, if the Shipper withdraws a greater quantity of Gas

than the Gas owned by the Shipper present in the System, the prices per chapter 8 below are applied to all excess quantities withdrawn.

2.4.6 Revision of the utilisation profiles and adjustment coefficients

The Storage Company carries out the simulations for the following Thermal Year in such a way as to allow the publication of all necessary information no later than the 1st of February prior to the start of the same Thermal Year.

Taking into account the possible changes, including significant ones, tied to the terminal part of the Withdrawal Phase and to possible changes of the assigned capacities in accordance with paragraph 2.4.2.3 above, the simulations for the subsequent Injection Phase can be updated no later than mid March, in order to allow Shippers to define an adequate seasonal scheduling.

For the same reasons, no later than mid October, the Storage Company tests for consistency with respect to the parameters used for the definition of the initial simulations, carrying out - e.g., in case of incomplete filling of the System - a revision aimed at better operational scheduling by Shippers.

This consistency test is also carried out on the basis of a joint technical analysis with the transport companies.

Since the adjustment coefficient and the related ranges of applicability are also strongly influenced by the schedule of Significant Works, as they are defined in paragraph 13.2 of the chapter “Scheduling and Managing Maintenance Operations”, and by the response of the reservoir in terms of available incremental performance consequent to the aforesaid works, the Storage Company reserves the right to change them if the aforesaid Significant Works or the performance undergo a change compared to those envisioned at the time they were determined. The aforesaid coefficients will be changed to such an extent as to assure in any case an injection or withdrawal profile that allows to keep at least equivalent the times provided for the withdrawal and injection phases by the previous coefficients, as well as the assigned capacity value CE_{MOD}.
Changes to the adjustment coefficients will be notified to the Shipper via registered letter, sent in advance via email, and published on the Website at least 15 days prior to their application.

The Storage Company also reserves the right to change the Utilisation profiles on a monthly basis if the actual progress of the emptying or of the filling are

not consistent with the utilisation profiles in force and with the available performance.

The Storage Company, in case of any redefinition of the utilisation profiles, of the adjustment factors and of their time interval of validity, takes into account the Shippers' needs carrying out all the action that can assure the greatest flexibility to the System.

2.5 INFORMATION PUBLISHED ON THE WEBSITE

On a yearly basis, the Storage Company publishes and updates, on its Website:

a. The geographic Description of the storage facilities, with their location;
b. The schematic representation of the storage facilities;
c. The list of the enhancements and of the planned disposals;
d. The Point of Entry on the RNG with the indication of the interconnected transport company.

In addition, no later than 1 February of each year, the Storage Company publishes on its Website:

e. The storage Capacities available for the mandatory services; defined in paragraph 2.4.4 of this chapter;
f. The operation and maintenance plans pertaining to the storage facilities it owns;
g. The technical-managerial constraints deriving from the Significant Works;
h. The utilisation profiles, the adjustment factors and the related ranges of applicability.