CHAPTER 2

DESCRIPTION OF THE STORAGE FACILITIES

AND THEIR MANAGEMENT

2.1 INTRODUCTION

The Storage Company offers a storage service that avails itself of the coordinated and optimised use of storage reservoirs currently undergoing changes in the optimisation and upgrading phase of the gas Cushion and the Working Gas.

The storage activity is currently being carried out through three reservoirs (Collalto, Cellino and San Potito e Cotignola) with exhausted gases of the conventional type and with simple expansion, and that are under concession granted by the Ministry of Economic Development (MSE).

The performance available comes from the optimised aggregation of the performance of the single storage sites attributed to the Storage Company in concession, determined considering the hydrocarbon properties of each one of them and also the existing restrictions on the surface systems and wells.

In order to meet the obligation of coordinated and integrated management of its capacities provided for by Article 12, paragraph 1 of Italian Law Decree 164 of 23 May 2000 and to guarantee transparency and non-discrimination to all System Shippers, the Storage Company has defined a single virtual hub for accessing the Storage System (Edison Stoccaggio Hub) through which the processes for reservation and assignment of the capacities reserved by the Shippers will be managed. The Storage Company offers Shippers its services through the Edison Stoccaggio Hub regardless of which specific storage site is activated during the injection and withdrawal phase.

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

2.2 GENERAL DESCRIPTION OF THE STORAGE SYSTEM

Based on what is established by Italian Legislative Decree 164/00, storing natural gas in reservoirs or deep geological units is performed based on a concession issued by the MSE to requesting user that have the necessary technical, economic and organisational capability.

From the technical system viewpoint, a storage site is made up of:

- The storage reservoir;
- The wells;

- The flow lines;
- The treatment and compression stations.

The plants making up the Storage System were designed and built in consideration of the period during which they were conceived and of their specific use, based on the domestic and international legislation on the sector, the consolidated experience acquired and with the final objective of guaranteeing operation distinguished by a high level of safety, reliability and operational efficiency.
A brief description of the types of storage, reservoirs, wells and systems mentioned above follows.

2.2.1 The storage reservoir

Underground storage sites of natural gas consists of geological structures having characteristics such as to permit the accumulation, the preservation and, when required, the withdrawal of natural gas.
Storage sites are considered conventional when built using reservoirs producing exhausted or semi-exhausted gases, semi-conventional when exhausted oil reservoirs or aquifers (i.e. geological structures containing water) are used, and special when they are built in abandoned coal mines or in cavities dug out in underground salt formations.

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

Exhausted gas reservoirs: the elements of greatest interest are the shape and size of the reservoir, the size and properties of the aquifer, gas-water contact, and the properties of the reservoir and covering rocks.
The physical parameters of the reservoir rock of greatest interest that must be carefully assessed are:

a. Interconnected porosity: the greater the interconnected porosity of the reservoir rock, the greater is the accumulation capacity of the natural gas;
b. Permeability: the greater the permeability of the reservoir rock, the greater it is suited to being used for storage;
c. Saturation in interstitial water: the lower it is, the better it is since it reduces the usable volume.

Another element to bear in mind is the “production mechanism” that affects the movements of the aquifer in the reservoir rock after the reservoir is filled and emptied. With reference to the production mechanism, there are:

i. Simple expansion reservoirs in which the aquifer remains basically at the same height during withdrawal and injection, offering high performance and fewer problems during production;

ii. Water drive reservoirs, in which the aquifer quickly rises during withdrawal and must then be cleared when injecting into the reservoir. Performance is limited in these reservoirs by the possible transport of water (withdrawal phase) and by the increase in pressure necessary to clear the water out of the reservoir (injection phase).

As regards the storage sites in aquifers, it is first of all necessary to find the geological structure, and best if it is the anticlinal type. This structure is identified with geological surface surveys, then located with geophysical systems.

The most important requirement of an aquifer storage site is its seal against the passage of gas through the covering rocks, which must have an adequate thickness and low permeability, like in the case of clayey formations; this requirement is due to the fact that in order to be able to inject the gas, the hydrostatic pressure is always exceeded.

For storage in salt formations, cavities made by dissolving the salt mass with water pumped through one or more wells and then used to extract the salt are used.
Knowledge of the shape of the cavity and of the properties of the rocks surrounding it are important elements for determining the minimum and maximum pressure on which this type of storage can be exercised.
Generally speaking, these storage sites do not have high working gases, but provide remarkable peak flow rates.

Storage in partially or totally exhausted oil reservoirs has characteristics similar to those in gas reservoirs converted for storage; therefore, some of the operating and development methods applied to the latter are valid.

In this case, injecting gas into an oil reservoir can be part of the secondary oil recovery project; in these cases, the classic advantages of storage are associated with those of additional recovery of oil.
It is also to be said that the treatment plants for giving the gas the necessary quality specifications before being introduced into the transport network are often different from those used in the previous types of storage since they must be able to retain the fraction of liquid hydrocarbons suspended in the gas.

2.2.1.2. *Technical hydrocarbon management of the conventional storage reservoirs*

Knowledge of the production parameters acquired during the primary production stage is essential for the technical hydrocarbon management of the conventional storage reservoirs.

The aforesaid parameters, and those acquired during the storage cycles, indeed allow the dynamic behaviour of the sites to be monitored, whether they are optimised or about to be optimised.
Monitoring the behaviour of the reservoirs allows appropriate reservoir behaviour simulation models to be implemented for the purpose of optimising use of the available capacities, thus preventing damage to the levels used for storage.

The main phases distinguishing each storage reservoir are:

- Injection phase: during this phase, the pressure in the reservoir rises as the injected gas volumes increase, and is conditioned by the petrophysical/geostructural characteristics of the reservoir, by the production mechanism and by the compression capacity of the surface systems. In particular, the accommodation capacity of the reservoir decreases with the progressive approach to the maximum pressure value; this value corresponds to the original static pressure of the reservoir or to the different value that may have been authorised by the MSE for the single storage reservoir;
- Withdrawal phase: during the withdrawal phase, the pressure in the reservoir drops as the withdrawn gas volumes increase, and is conditioned by the petrophysical/geostructural characteristics of the reservoir and by the production mechanism. Specifically, the withdrawal capacity of the reservoir decreases as the pressure drops since it is the function of the difference between static and dynamic pressure applicable to the wellhead.

The evolution of performance in injection and withdrawal of every single reservoir is therefore the function of the trend of the gas volumes injected/withdrawn over time and therefore of the level of pressure of the same reservoir.

In the case of reservoirs still in the upgrading phase, the injection and withdrawal capacity is mainly limited to the surface plants, the type of wells and the pressure conditions on the national gas pipeline network (NGPN) to which the system is connected, while the reservoir pressure is not a real management restriction since it is not yet possible to reach the original static pressure in the injection phase.

The parameters distinguishing a storage reservoir are:

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

Cushion gas is the amount of gas in the reservoir necessary to use the storage site, and it is the minimum necessary amount present or injected into the reservoirs during the storage start-up phase, which is necessary to always keep in the reservoir. The function of the cushion gas is to allow working gas to be withdrawn while keeping the reservoir at a certain pressure level that serves to impede the aquifer from rising without jeopardising the hydrocarbon characteristics of the storage reservoirs 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 the Hydrocarbon Storage, Modulation, Operational and Strategic Balancing Services, 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 amount of gas that the reservoir is able to withdraw and inject in one hour (shown at the daily value multiplying the hourly flow rate by 24).

2.2.2 The wells

The wells connect the mineralised levels of the reservoir with the surface structures and allow the gas to be handled and other specific auxiliary activities to be carried out, such as re-injection of the production waters, if possible, and reservoir monitoring.
Each well is equipped at the surface with equipment able to separate water at the free and/or condensation state and with a control system connected to a station able to ensure overall protection of the well and of the other equipment through an air-hydraulic type of control system.

The well part directly in contact with the mineralised levels, called "completion", is specifically structured to allow injection and withdrawal of the gas directly in/from the rock formation.

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

From the technical viewpoint, the structure of the wells can be described as follows:

- on the outside, toward the crossed geological formations, the well is made up of concentric hole sections covered by steel pipes (casing) with cement filling the anular space between the formation and the casing. This filling guarantees the mechanical anchorage of the pipes and the hydraulic insulation from the formations they cross;

- other steel pipes are located inside the casing, called *“completion tubing”*, and their purpose is to guarantee the flow of gas in totally safe conditions.

To guarantee the best performance, the wells for gas movement are sometimes completed with the *“sand control”* technique by positioning special filters (*“gravel pack”*) able to hold back the finer solid components of the rock formation at the bottom of the well.
The casings and production tubing are connected on the surface with the set of valves making up the “wellhead”, the only part of the well assembly seen on the surface.

Each gas injection/withdrawal well is equipped with *“safety valves”* that are able to automatically stop the flow of gas from the reservoir after any anomalies of the surface systems directly connected with the well.

From the operational viewpoint, each well is run with a pre-determined *deltaP* (maximum difference in admissible pressure between the static pressure and the dynamic pressure to prevent problems for the formation and well and, at the same time, to guarantee continuity of the service supply) that takes into account petrophysical characteristics of the level concerned, 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 in the Storage System are classified based on their use:

- Operational wells, used for the gas movement both in injection and in withdrawal;
- Monitoring wells, used to control pressures and the degree of gas/water saturation in the mineralised levels of the reservoir;
- Possibly wells for re-injection of the water coming from the formation during the gas withdrawal phase following appropriate separation from the gas itself.

2.2.3 Connecting flow lines

The wells, isolated or grouped in “clusters”, are distributed so as to properly cover the reservoir area and for this reason can also be located several kilometres away from the compression and treatment plants. Connecting pipes called *“flow lines”* are therefore used to permit movement of the gas between the wells and the plants.

These lines are equipped with their own gate valves and safety devices for management and control, both local and remote.
The size and characteristics of the flow lines are also important. In fact, they affect the performance of the System since during its journey the Gas sustains a load loss (reduced pressure) proportionate to the Gas flow passing through the pipes.

2.2.4 Treatment and compression stations

All of the machinery and systems necessary for performing the process and control operations for injecting the natural gas coming from the transport system in the underground reservoirs and for withdrawing volumes of gas from the reservoir to the transport network are installed in the storage station.
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 being introduced into the national gas pipeline network (or NGPN);
- Compression in the reservoir and/or in the NGPN.

2.2.4.1. *Treatment stations*

The gas injected into the reservoirs becomes enriched with water and sometimes with greater hydrocarbons (which condense into gasolene at the surface) present in the cracks of the geological formations used for storage. The presence of water in the extracted gas is particularly accentuated in the aquifers or in the reservoirs with the water drive production mechanism.
This is why the gas, before being returned to the NGPN, must pass through the wellhead separators, the station separators and then go through the treatment plants.

2.2.4.1.1. Notes on the treatment plants

The treatment plants can be divided into first stage plants and final treatment plants.

The first stage plants comprise:

- Separators;
- Heaters;
- Pumps for injecting hydrate formation inhibitors (glycol and/or methanol).

The job performed by the separators, usually installed at the wellhead and at the inlet/outlet of the treatment station, is treating the free water (or other liquids such as glycol and/or gasolene) and the water that condenses due to the cooling and reduction in gas velocity because of the change in diameter of the separator.

The function of the heaters and glycol/methanol injection pumps is to prevent the formation of hydrates in the equipment and in the lines that run from the wellhead to the treatment station.

The final treatment plants are:

- Dehydration by absorption plants (glycol plants);
- Dehydration by cooling plants (LTS);
- Solid bed treatment plants.

The treatment plants currently installed in the Storage Company stations are glycol plants. Triethylene glycol is used in these plants for dehydrating gas. The water associated with the gas is absorbed by simple physical contact between the wet gas and the glycol; the glycol saturated with water is then recovered and sent to a regeneration circuit to later be reused in the dehydration process.

2.2.4.2. *Compression stations*

During the withdrawal phase, both the conventional and semi-conventional storage sites need compression only towards the final stage of the cycle since the reservoir pressure on average stays above that of the NGPN with which they are connected (free flow). The amount of operational working gas that can be extracted without need for compression depends on the production mechanism and on the pressure value reached at the end of filling.

2.2.4.2.1. Description of the compression station

The compression station is located between the national gas pipeline network and the pipeline connecting the station to the storage wells (flow line). The station is connected to the national gas pipeline network and the flow line with pipes properly sized to contain the load losses and limit the noise generated by the gas in transit. The pipes are called “intake and delivery manifold”, depending on the direction of the gas and the inlet and outlet from the compressor.

The compression station is usually made up of multiple modular units that are connected to each other with valves installed on each manifold. The valves allow different types of operation, different running conditions and the maintenance operations on the units to be configured without jeopardising the overall operation of the plant.
The compression station is made up of the compression units (that may be more than one) equipped with feeding, cooling and flow rate control/adjustment systems.

2.2.4.2.2. Sizing of the compression stations

The main function of the compression stations at the storage sites is to enable the injection volumes of gas into the reservoir after being withdrawn from the national gas pipeline network at a pressure level lower than that of the reservoir. The compression can also be useful during the withdrawal phase, usually towards the end, when the reservoir pressures tend to reach the values of the transport network. Use of compression during this stage nevertheless is marginal.
In sizing the compressors, the injection cycle is therefore mostly binding.
So at the basis of the sizing are the daily flow rates, and the intake pressure (pressure at which the Gas arrives from the national gas pipeline network) and delivery pressure at which the compressor has to work, bearing in mind the maximum instantaneous intake pressure limits applicable in order to prevent damage to the reservoir and to the covering rocks.

2.2.4.2.3. Type of compressors

The compressors are divided into two classes:

- Reciprocating compressors
- Centrifugal compressors

The reciprocating compressor is part of those machines called volumetric compressors because they reduce the volume available to the fluid in order to increase its pressure.
There are various types of reciprocating compressors: horizontal, vertical, “V”-shaped and square. Furthermore, the cylinders in reciprocating compressors can be double acting and single acting.
The centrifugal compressor, on the other hand, turns the kinetic energy of the fluid into pressure energy.

The compressors are coupled with motors that move their mechanical parts. The power supply of the motors can be electric (constant speed or possibly with a speed variator), or gas-powered.

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

2.2.4.2.4. Configuration criteria of the compression stations

Many parameters are considered when configuring a compression station, including the amount of flexibility that the system must allow, the energy output and efficiency of the machine and the level of investment, which all play a key role.
For the typical flow rates of the Storage Company sites, the reciprocating compressors generally best meet the flexibility requirements while at the same time preserve higher outputs than the centrifugal compressor.

2.2.4.2.5. Compression monitoring and control systems

Managing storage sites demands a certain flexibility in terms of daily peak performance, both for purely commercial considerations and constraints arising from the characteristics of the reservoir.

The interval of the withdrawal and injection flow rates depends on the filling of the reservoir and on the instantaneous working pressures, and may be very extensive; the need to be able to adjust the pressure and flow rate parameters at the compressor outlet is therefore an essential factor. When possible, it is preferable to make the adjustments by changing the speed of rotation of the motor shaft connected to the compressor. This is done, for example, when the compressor is connected to gas combustion motors (the combustion charge is changed) or to variable speed motors.

If the motor runs at constant speed, adjustment is carried out by recycling. There are also other adjustment possibilities, but tied to the type of compressor and to its construction elements; in reciprocating compressors, it can be done by changing the clearance volume of the compression chambers, exclusion of the effects, and the on/off system (not recommended due to the impact that it can have on the machines and instrumentation).

2.3 DISPATCHING AND MANAGEMENT

Dispatching is a fundamental element of the system since it is the operations, control and supervision centre for:

- Monitoring the plant safety of the process;
- The supply provided by the Storage System;
- Performing specific activities linked to the service.

Dispatching makes use of dedicated software that minimises the controls and manipulations that the operator is required to perform on the single parts of the storage facility.

Specifically, the computerised management systems are used for the following activities:

1. Controlling the production and the treatment and compression processes;
2. Optimising production;
3. Managing commercial problems.

2.3.1 Controlling the production and the treatment and compression processes

The activity entails:

a. Monitoring operation of the site systems and instrumentation at all times while guaranteeing the safety of the equipment, people and environment at all times;
b. Remote management of the plants in conditions where personnel are totally or partially absent, thus significantly cutting the operating costs and making production control more effective and dynamic;
c. Centralising management and production planning to improve the response time for many market demands.

2.3.2 Optimising production

The activity entails:

a. Optimally using the various hydrocarbon characteristics of each site, also when there are surface constraints, in such a way as to significantly increase performance volume moved from the storage system being equal;
b. Optimally using each site level based on its petrophysical properties and production mechanism;
c. Determining the daily flow rate of each well at all times in consideration of its location, type of completion, and the draw-off/storage achieved.

Injection and withdrawal capacities are optimised starting from the overall demand on the different storage sites (basic or peak storage sites) forming the system, considering the constraints on the treatment/compression plants and on the national gas pipeline network.

As mentioned above, the storage sites are divided into two broad categories:
- Basic storage sites;
- Peak storage sites.

A brief description of the two types of storage sites follows.

2.3.2.1. *Basic storage sites*

They are used during the entire winter season and are generally storage sites that have high operational working gas and a slow decline of daily peak capacity during the withdrawal stage.
Most of the storage sites in exhausted gas reservoirs and a certain part of the storage sites in aquifers belong to this category.

2.3.2.2. *Peak storage sites*

They are used only for short periods during the winter season in order to meet the daily demand peaks; the number of days of use may range from a minimum of 15-20 days to a maximum of 40-50 days, depending on their size.
The operational working gas is usually less than 0.5 Gm3, and the decline of the daily peak during withdrawal is somewhat accentuated.
Most of the storage sites in salt cavities and a certain part of the storage sites in exhausted gas reservoirs and in aquifers belong to this category.

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

The total demand in the different storage reservoirs making up the System is distributed while optimising the hydrocarbon properties of each one of them and considering any constraints on the treatment/compression plants and on the national gas pipeline network.
This methodology of use and management of the Storage Systems makes it possible to identify the optimum withdrawal/injection profile of each reservoir with the aim of ensuring the System the best possible performance.
In other words, the methodology both maximises the peak availability of the System withdrawn volume being equal and ensuring filling in the time frame planned for the injection stage and with the appropriate flexibilities.
The input data for optimisation are built by the withdrawability/injectability curves of all the sites making up the Storage System in question and by the load curve that the System has to meet.

2.3.3 Managing commercial problems

The activity entails:

- Managing the reservation, assignment and reassignment processes;
- Managing the processes of allocating the gas moved from storage;
- Managing the invoicing processes.

The Storage Company has developed an IT System (hereinafter also Escomas) to make available the functionalities stated below in an impartial and non-discriminatory manner and to optimise management of the following processes in terms of effectiveness and efficiency:

- Assignments of Storage capacity at the beginning and during the Thermal Year;
- Availability of supplies 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, where envisaged;
- Other functionalities and information.

This system and its functionalities will be better described in the sections and chapters below, and in the Escomas user's manual.

2.4 DETERMINING THE AVAILABLE CAPACITIES

Determining minimum supplies that can be guaranteed and then daily distributing the overall demand over the storage reservoirs making up the system is done while optimising the hydrocarbon properties of each one of them (basic or peak storage sites) and considering any constraints on the treatment/compression plants and on the transport system and the schedule of works to optimise, upgrade and develop the System.

This methodology of use and management of the storage systems makes it possible to identify the optimum withdrawal/injection profile of each reservoir with the aim of ensuring the System the best possible performance.

In other words, the methodology both maximises the peak availability of the System withdrawn volume being equal and ensuring filling in the time frame planned for the injection stage.

The input data for optimisation are built by the withdrawability/injectability curves of all the sites making up the Storage System in question and by the load curve that the System has to meet; for the sake of completeness, remember that the load curve is nothing other than the quantity of gas that the set of sites to be optimised must meet and that the withdrawability/injectability curves are made with the three functions:

- Qg = daily flow rate based on the draw-off/storage
- S = draw-off/storage based on time
- P = pressure based on the draw-off/storage

The gas volumes are moved and transferred between the transport system and the underground storage reservoirs through the natural gas storage station. During the development and upgrading stages of a storage site, the storage station facilities (flow line, treatment and compression system) may be a constraint in determining the maximum supplies that can be withdrawn from the Site.

During operations management, the configuration and type of surface systems may represent limits to the flexibility of the Storage System (flow reversal, minimum withdrawable flow rates).

All equipment installed at the stations is sized to perform a complete storage cycle, bearing in mind the maximum supplies that can be obtained from the reservoir. The cycle is made up of an operational injection (or storage) stage and an operational withdrawal (or production) stage in which the volumes stored in the previous stage are redelivered to the system from which they were withdrawn.

Therefore, determining the Storage Capacity is based on:

- Hydrocarbon aspects;
- Technical-management aspects.

The methods based on which the Storage Capacities are defined are described in the following sections.
The above capacities may be subject to changes over time since they depend on the actual draw-off and storage at the end of the injection and withdrawal campaign, the technical-management conditions of the transport system connected to the system and the work schedules for interventions on the system.

2.4.1 Hydrocarbon aspects

Storage Capacity first of all depends on the geometry of the reservoir and on its geophysical properties, which are identified through the following activities:

a. Geological study of the structure identified and of the covering rocks;
b. Study of behaviour during the production stage in the case of exhausted or semi-exhausted gas reservoirs (conventional storage sites);
c. Dynamic simulation of behaviour of the structure in the injection and withdrawal stage using specially drawn up mathematical models;
d. Determination of the supplies with filling both at the original pressure and at a pressure higher than the original pressure, assuming different dynamic pressure values at the wellhead;
e. Determination of the supplies based on the number and type of wells (vertical, horizontal wells) and the type of completion (completion with gravel pack, large diameter tubing, etc.).

In the case of exhausted or semi-exhausted gas reservoirs, the studies at points a) and b) have already been conducted and updated during the reservoir production lifetime; in particular, the analysis of the dynamic behaviour made during the primary production stage allows the characteristic parameters of the reservoir-aquifer system (single expansion, moderate water drive, strong water drive production mechanism) that are at the basis of the sizing in terms of capacity and productivity of the future storage.

The simulations that we briefly mentioned allow the attainable technical performance and other storage parameters (working gas, withdrawal/injection peak, cushion gas) to be determined as the reservoir pressure and dynamic pressure of the wellhead change.

2.4.2 Technical-management aspects

In addition to the hydrocarbon aspects, the Storage Capacity also depends on several technical-management parameters:

a) *Major Maintenance Plan*: the services made available by the Storage Company are heavily influenced by the Major Maintenance operations, as defined in paragraph 13.2 of the chapter “Scheduling and Managing Maintenance Operations” and notified to the MSE pursuant to the Bill. A change in the times or type of operation may change the availabilities of the system for an amount higher than 40% of the available performance.

b) *Delivery/Redelivery Pressures*: the purpose of the compression station is to raise the pressure of the gas coming from the national gas pipeline network to values such as to permit its injection into the reservoir during the filling (injection) stage or, vice versa, the introduction into the national gas pipeline network during the reservoir emptying (withdrawal) stage. The working pressures of the storage reservoirs considerably vary depending on the filling level and are, on average, higher than the working values of the primary pipeline network; therefore, the minimum guaranteed pressure level is an extremely important management constraint for allowing the Performances to be guaranteed, especially during injection.

c) *The characteristic trend of the modulation requirements of the Shippers*;

d) *Flow reversibility*: in order to be able to provide the physical Reverse Flow service explained in sub-paragraph 3.2.1.1, it is necessary that the Storage Company perform the following activities:

   - Alter the set-up of the station (switching compressors on/off, opening/closing valves, enabling/disabling the dehydration plant, etc.);
   - Alter the set-up of the well areas (opening/closing valves, switching on/off separators, heaters, regulating valves, etc.);

- Reverse the technical and fiscal measurements both at the station and at the well areas;
- Request the connected Transport Company to reverse the corresponding metering station;
- Inform the Ministry of Economic Development, UNMIG Division, of all of the above operations by fax, specifying the metering lines in operation.

Therefore, as specified in chapter 6, "Injection and withdrawal reservations and commitments", the Shipper can request the reverse flow service only of the virtual type since it is not possible to perform the actions above in a time span compatible with the hourly renominations.

e) *Plan of periodic checks and other scheduled operations:* any type of operation needing interruption of the activities on part of the System obviously has impacts on the available services.

2.4.3 Determining System Performances

Considering what has already been explained in this chapter, the Storage Company simulates the dynamic behaviour of its storage reservoirs and performances associated with it using computing tools and dedicated software. The simulations conducted have the objective of optimising the services offered in the Injection and Withdrawal Stages in compliance with the standards issued by the MSE and with the provisions of ARERA while taking into consideration petrophysical parameters and the production history of each storage reservoir.

2.4.3.1. *Simulation tools*

As part of its activity to develop its own reservoirs that are not yet optimised, the Storage Company is developing the dynamic behaviour simulation models of the storage reservoirs and the physical quantities associated with them (injected/withdrawn volumes, static and dynamic pressure, storage capacity in terms of Space, Injection and Withdrawal availability over time, etc.). It currently simulates the behaviour of its sites both using an "Eclipse" 3D mathematical simulator (normally used in the oil industry) and using specially developed models. These models, based on the geodynamic and structural data acquired over time and on the production history of the reservoirs during both the primary production and storage stages, are constantly updated and recalibrated.

Specifically, all of the static and dynamic models reflect the geodynamic, physical and petrophysical parameters characteristic of each reservoir. It is in fact emphasised that the dynamic behaviour of a reservoir is actually neither linear nor stationary, so the reservoir needs a precise definition of the relevant model for its management safe from possible damage.
In the case of storage sites not yet optimised and that are therefore subject to continuous plant changes, and for which new wells are being built, it is evident

that the simulation models are mainly based on information collected during the production stage and so they still do not contain information on the behaviour of the new wells and of the reservoir in the new conditions.

2.4.3.2. *Technical and management constraints and input data for simulations*

The Space values and peak Injection and Withdrawal availabilities regarding the single reservoirs are determined starting from the above-mentioned simulations in observance of the reservoir, well, technical surface equipment constraints.
The simulations necessary for determining the performances are performed considering distinct input data for the injection and withdrawal stage, without prejudice to the constraints of each storage reservoir, depending on the production history, such as the state of the wells, their location with respect to the hydrocarbon area, their type of completion and the shut-downs or partialisations affecting the injection and/or withdrawal stage due to upgrading or development operations.

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

- The maximum static reservoir pressure not to be exceeded, which is equal to the original static pressure or to the different value authorised by the MSE for the single storage reservoir in the case of optimised reservoirs;
  For reservoirs in the upgrading stage and not yet optimised, the pressure considered in the simulations is the one expected to be reached with the volume deemed possible to inject, considering the upgrading operations and/or constraints existing on the current surface systems.
  The injectable volume and associated pressure are therefore calculated repetitively by setting whether it is possible to withdraw during the withdrawal stage the gas injected by the Shippers during the previous injection stage as the constraint.

- The maximum receiving capacity of each well during the injection stage;
- The maximum receiving capacity of each reservoir during the injection stage, which depends on the properties of the reservoir and on the operating limits of the compression plants;
- The shut-downs that become necessary for measuring the static bottom hole pressure at the end of the injection stage, as required by Article 18 of Italian Ministerial Decree of 26/8/05, and those that may be scheduled during the cycle. These latter shut-downs are particularly important, above all during the reservoir upgrading and development stage, when monitoring the trend of the restocking becomes necessary;
- The operations schedule authorised by the MSE for carrying out Major Maintenance;

- The operating times of the Injection Stage, which must be about 6-7 months.

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

- The maximum withdrawal capacity of each well;
- The maximum capacity of each reservoir during the withdrawal stage, which depends on the properties of the reservoir and on the maximum operating limits of the surface plants;
- The minimum withdrawal performance, usually coinciding with the minimum limit of the treatment and compression plants;
- The minimum dynamic wellhead pressure value;
- The maximum quantity of producible water on a daily and annual basis, in compliance with the volumes to be re-injected into underground levels;
- The shut-downs that become necessary for measuring the static bottom hole pressure at the end of the withdrawal stage, as required by Article 18 of Italian Ministerial Decree of 26/8/05, and those that may be scheduled during the cycle. These latter shut-downs are particularly important, above all during the reservoir upgrading and development stage, when monitoring the trend of the withdrawal becomes necessary;
- The operations schedule authorised by the MSE for carrying out Major Maintenance;
- The operating times, about 5-6 months.

The injectability and withdrawability curves of the models of each site form the basis on which determination of the capacities made available during the assignment stage.

2.4.3.3. *Results of the simulations*

The results of the simulations described in the forgoing section consist of the injectability and withdrawability curves of the Storage System that associate the moved volumes with the peak availability.

- Connections between Space and Injection (injectability curves): optimum Injection profile and peak Injection availability

The optimum Injection profile is initially defined in January - taking into account the best forecasts of the evolution of the overall withdrawal up until the end of the Thermal Year and the technical and management constraints described in paragraph 2.4.2 - on the basis of the following operational concepts:

- Injection of high volumes during the initial phase, existing systems permitting.
- Optimisation of the injection flow rates after the initial phase, based on the actual reservoir capacities and the systems in order to maximise the injection availability.

Based on these consideration, the optimum filling conditions and the consequent trend of the peak availability during Injection, the reverse function of the total volume injected, are defined.

The purpose of the decreasing trend of this availability over time is to direct the injection of the monthly volumes according to the real capacities of the reservoirs without causing overpressure phenomena, which would consequently result in a subsequent reduction of volumes to be injected.
In order to take under adequate consideration the operational flexibility demanded by the System Shippers and the fact that the optimum profile might not be precisely observed, alternative minimum and maximum progressive profiles that in any case ensure proper overall filling of the reservoirs have proven correct.

- *Connections between Space and Withdrawal (withdrawability curves): optimum Withdrawal profile and peak Withdrawal availability*

The Withdrawal profile for the next Thermal Year is initially defined in January, bearing in mind the complete filling of the assigned Space, the upgrading, optimisation and development operations, and the technical and management constraints described under point a), with the goal of maximising the space and withdrawal flow rate made available to the Shippers.

The Withdrawal profile is determined based on the following criteria:

- Keeping the maximum withdrawal capacity available over time;
- Withdrawal of high volumes during the period of greatest climate demand (between January and February);
- Optimisation of the withdrawal flow rates, based on the actual reservoir capacities in order to maximise the withdrawal availability of the Storage System;
- Maximisation of the operational working gas made available to the Shippers.

The Storage Company determines the use profiles and the withdrawal adjustment factors consistent with the trend of the optimised performance curve of the System and can offer additional Withdrawal performances to the Shippers continuously or interruptedly, bearing in mind the need to maintain the continuity of the optimised withdrawal performance up until the end of the Withdrawal Stage.

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

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

Space or S

The total space made available for the assignment is defined based on the injectability and withdrawability curves of the System, and on the forecasted assignment 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 in the assignment assumptions formulated in terms of distribution of the capacities available in the different types of service alters the total volume made available.
For example, an incremental space assigned for the hydrocarbon storage service does not simply reduce the space assignable for the modulation service, but indeed reduces the total assignable space.
It is therefore evident that if the requests for the storage services with higher assignment priority should be other than those assumed, the Storage Company should recalculate and again publish the data on the S, PI and PE capacities available before the end of the assignment cycle.
In order to offer the services, the Storage Company makes available to the Shippers:

- Space for the Modulation Storage service (S_{MOD}), including the Space for the Constant Peaks of Modulation service ($S_{MOD,PC}$).

If further Space capacity becomes available during the Thermal Year, it will be assigned as primary capacity on a monthly, weekly basis in the competitive procedures described in paragraph 5.9.2.1 for the Modulation Service on a monthly, weekly, daily basis described in paragraph 3.2.2.

Injection Flow Rate or PI

The total PI made available for assignment is defined based on the technical capacity of the system and has a decreasing trend during the Injection Stage depending on the progressive draw-off, while it is made available during the Withdrawal Stage depending on the characteristics of its storage system and according to the methods described in sub-paragraph 3.2.2.1 of the chapter "Description of services".

In order to offer the mandatory services, the Storage Company makes available to for assignment a CI capacity equal to the value of the PI available at the beginning of the injection stage:

- Injection Flow Rate for the Modulation Storage service and to replenish the Strategic Storage (CI_{MOD}), including the Injection Flow Rate for the Constant Peaks of Modulation service ($CI_{MOD,PC}$).

If further Injection capacity becomes available during the Thermal Year, it will be assigned to the shippers while modifying the use coefficients or, if it is a capacity not sold during the assignment procedures on an annual and interim basis as described in paragraph 5.8.2.4 and paragraph 5.9.1, as primary capacity on a monthly, weekly and daily basis in the competitive procedures described in paragraph 5.9.2.1 for the Modulation Service on a monthly, weekly, daily basis described in paragraph 3.2.2.

<u>Withdrawal Flow Rate or PE</u>

The total Withdrawal Flow Rate made available for assignment is determined based on the technical characteristics of the system and has a decreasing trend depending on the total storage of the system.
In order to offer the mandatory services, the Storage Company makes available to for assignment a CE capacity equal to the value of the PE still available at the end of the storage of the modulation Working Gas:

- Withdrawal Flow Rate for the Modulation Storage service and to replenish the Strategic Storage (CE_{MOD}), including the Withdrawal Flow Rate for the Constant Peaks of Modulation service ($CE_{MOD,PC}$).

If further Withdrawal capacity becomes available during the Thermal Year, it will be assigned to the shippers while modifying the use coefficients according to the methods described in paragraph 3.2.1.4 or, if it is a capacity not sold during the assignment procedures on an annual and interim basis as described in paragraphs 5.8.2.4 and 5.9.1, as primary capacity on a monthly, weekly and daily basis in the competitive procedures described in paragraph 5.9.2.1 for the Modulation Service on a monthly, weekly, daily basis described in paragraph 3.2.5. Specifically, the withdrawal capacity will be sold in these competitive procedures during the injection stage.

2.4.4 From the System performances to the available Capacities

2.4.4.1. *Strategic Storage Service Capacities*

The Storage Company determines the Space available for the Strategic Storage Service (hereinafter S_{STR}) to the extent of what lies within its competence, deriving from the distribution carried out between the storage companies as compared to the total quantity established by the MSE.

2.4.4.2. *Modulation Service Capacities*

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

- The Space (hereinafter S_{MOD}) allocated to the Modulation Service, as defined below in paragraph 3.2.2, equals:

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

where S is equal to the total Space made available and possibly revised for assignment as described in forgoing paragraph 2.4.3.3.

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

Where:

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

S_{MODU} is the Space offered for the Flat Modulation Service;

$S_{MOD,PC}$ is the space allocated to the Constant Peaks of Modulation Service described below in paragraph 2.4.4.5.

The Ministry of Economic Development determines the division of S_{MOD} with annual measures.
Pursuant to the Decree of the Ministry of Economic Development in force at the time of assignment at the beginning of the thermal year, Edison Storage does not assign capacities for the Flat Modulation Service.

Space S_{MODP} is in turn divided into

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

and similarly

Space S_{MODU} is in turn 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 Flat Modulation Service

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

The seasonal services contemplate availability of Injection Capacity during the period falling between the month after the one when the Capacities are assigned and the month of October.

The monthly services contemplate availability of Injection Capacity only during the month after the one when the Capacities are assigned.

The Capacities for the Peak Modulation Service are made available by the month of March for assignments at the beginning of the thermal year and are by priority offered for the Seasonal Peak Modulation Service, according to the assignment on annual basis procedures described in paragraph 5.8.2.1.

In the case in which there should be quantities not assigned at the end of the allocation process described above, Edison Stoccaggio will define the assignable quantity for the Peak Modulation service with injection in the month of April and, should additional capacities become available, Edison Stoccaggio will make these quantities available through assignments when the Thermal Year has commenced, based on competitive procedures (procedures to assign capacity on an interim basis pursuant to paragraph 5.9.1) separate for the Seasonal and Monthly Peak Modulation Service.

The quantities of Space for the monthly products are repeatedly determined following the results of the assignment of seasonal products and depending on the injection capacity not assigned that is available for the month of assignment. For example, if capacities should be left over after the procedure to assign 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 will be determined as the minimum value between the available Space not assigned for the Seasonal Peak Modulation Service and the maximum quantity injectable in only the month of April.

Consequently, if capacity should remain after the assignment procedures for month m-1 of the seasonal product and monthly product starting in month m, by repeating the procedure described above Edison Stoccaggio will make available in month m:

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

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

$$CI_{MOD} = CI$$

where CI is equal to the total Injection Flow Rate made available and possibly revised for assignment as described in forgoing paragraph 2.4.3.3.

The Injection Capacity for the Modulation service CI_{MOD} is divided into a portion allocated to the peak modulation service, a portion allocated to the flat modulation space and a portion allocated to the constant peaks of modulation space.

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

Where:

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

CI_{MODU} is the Injection Capacity offered for the Flat Modulation Service;

$CI_{MOD,PC}$ is the injection capacity allocated to the Constant Peaks of Modulation Service described below in paragraph 2.4.4.5.

Determination of the CI_{MOD} distribution is established by the Storage Company according to the following criterion of proportionality:

$CI_{MODP} = (CI_{MOD} - CI_{MOD,PC}) \times S_{MODP}/(S_{MOD} - S_{MOD,PC})$

$CI_{MODU} = (CI_{MOD} - CI_{MOD,PC}) \times S_{MODU}/S_{MOD}(S_{MOD} - S_{MOD,PC})$

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

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

and similarly

the Injection Capacity for the Flat Modulation Service CI_{MODU} is in turn divided 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 Flat Modulation Service

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

The injection flow rate associated with the single product of the Modulation Service will be equal to:

$CI_{MODi,k} = CI_{MODi} \times S_{MODi,k}/S_{MODi}$

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

$CI_{MOD,PC}$ is determined as space $S_{MOD,PC}$ divided by 100 days.

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

$$CE_{MOD} = CE$$

where CE is equal to the total Withdrawal Flow Rate made available and possibly revised for assignment as described in forgoing paragraph 2.4.3.3.;

Note that the CE_{MOD} for the modulation storage service can be formed by a continuous component and possibly by an interruptible component.

The Withdrawal Capacity for the Modulation service CE_{MOD} is divided into a portion allocated to the peak modulation service, a portion allocated to the flat modulation space and a portion allocated to the constant peaks of modulation space.

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

where $CE_{MOD,PC}$ is the withdrawal capacity allocated to the Constant Peaks of Modulation Service described below in paragraph 2.4.4.5.

The Peak Modulation Service has associated a withdrawal capacity (CE_{MODP}) equal to the space capacity multiplied by the ratio between the maximum withdrawal performance associated with said service as defined by the Decree of the Ministry of Economic Development in force at the time of assignment and the total space capacity available at each storage company for said service as defined by the same decree.
The performances associated with the withdrawal capacity assigned to each Shipper for the Peak service are determined, in compliance with the constraints set by the Decree of the Ministry of Economic Development in force at the time of the assignment, as the product between the same capacity and the adjustment factor, a variable depending on the shipper’s stock, defined in this Code, and updated in compliance with the provisions of the aforesaid decree.
For the Peak Modulation Service, the profiles of use of the Withdrawal Capacity are annexed to the Ministerial Decree in force at the time of assignment at the beginning of the thermal year.

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

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

The withdrawal capacity of the Constant Peaks of Modulation service $CE_{MOD,PC}$ is determined as space $S_{MOD,PC}$ divided by 100 days.

During the thermal year, the Storage Company organises the capacity assignment procedures on a monthly, weekly and daily basis as described in paragraph 5.9.2.1 for the Modulation Storage Service on a monthly, weekly and daily basis.

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

The Storage Company determines the Capacities for the Modulation Services on a monthly, weekly, daily and "periodic" basis and assigns them according to the procedures described below in paragraphs 5.9.2.1 and 5.9.2.2 in the following way:

a) the Space made available on a monthly and weekly basis ($S_{MODP,M}$, $S_{MODP,W}$, $S_{MOD,PC,M}$, $S_{MOD,PC,W}$) is established on the basis of the Space capacities that become available during the Thermal Year, and on the basis of the progressively available quantity bearing in mind the quantity of Gas withdrawn and injected and of the monthly, weekly and daily plans of the Shippers;

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

- During the Withdrawal Period

    - The Injection Capacity on an additional continuous monthly, weekly and daily basis, if available, compared to the Injection Capacity during the available Withdrawal stage assigned at the beginning of the thermal year;
    - Any additional Injection Capacity during the withdrawal stage described in the forgoing point on non-scheduled interruptible basis and not allocated in the first session pursuant to 5.9.2.1 below.

- During the Injection Period

    - The Injection Capacity on an additional continuous monthly, weekly and daily basis, if available, compared to the Injection Capacity (CI_{MODP} e $CI_{MOD,PC}$) described in paragraph 2.4.4.2 and compared to that assigned to the shippers by modifying the adjustment coefficients and, only on a daily basis, as “in advance” capacity as described in paragraph 3.2.1.5;

- The Injection Capacity on the interruptible monthly, weekly and daily basis pursuant to the forgoing point, on an unscheduled interruptible basis and not allocated in the first session as described below in paragraph 5.9.2.1.

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

- During Withdrawal Period
  - On an additional continuous monthly, weekly and daily basis compared to the available Withdrawal Capacity (CE_{MODP} e $CE_{MOD,PC}$) described in paragraph 2.4.4.2 and compared to that assigned to the shippers by modifying the adjustment coefficients pursuant to paragraph 2.4.4.9 below and, only on a daily basis, as “in advance” capacity as described in paragraph 3.2.1.4;
  - The Withdrawal Capacity on the interruptible monthly, weekly and daily basis pursuant to the forgoing point, on an unscheduled interruptible basis and not allocated in the first session as described below in paragraph 5.9.2.1;

- During Injection Period
  - On a continuous monthly, weekly and daily basis as Withdrawal Capacity during the Injection stage described in paragraph 2.4.4.7, assigned according to the competitive procedures pursuant to paragraph 5.9.2.1;
  - The Withdrawal Capacity on the interruptible monthly, weekly and daily basis pursuant to the forgoing point, on an unscheduled interruptible basis and not allocated in the first session as described below in paragraph 5.9.2.1.

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

The Storage Company determines the Injection and Withdrawal Capacities for the Modulation Services (CI_O, CE_O) and assigns them on a daily basis according to the procedures described below in paragraph 3.2.1.2, as confirmed after the procedures described in paragraph 6.6.5.

2.4.4.5. *Capacity for the Constant Peaks of Modulation Service*

The Capacity for the Constant Peaks of Modulation Service is made available at the beginning of the Thermal Year in the following way:

- the Space ($S_{MOD,PC}$) is defined within the scope of the quantity identified by the Ministry of Economic Development in the measures issued to implement Article 14 of Italian Law Decree no. 1 of 24 January 2012 on the subject of determining storage capacities to allocate to the services offered to the gas system shippers;
- the Injection Flow Rate ($CI_{MOD,PC}$) is equal to $S_{MOD,PC}$ divided by 100 days;
- the Withdrawal Flow Rate ($CI_{MOD,PC}$) is equal to $S_{MOD,PC}$ divided by 100 days.

For these capacities the provisions concerning the profiles of use of the storage capacities described below in paragraphs 2.4.5. and 2.4.6 are not applied.

2.4.4.6. *Reverse Flow Rate Service Capacity*

Taking into account what is specified in paragraphs 2.4.2 and 2.4.3.3, the Storage Company determines the Withdrawal Capacity during the injection stage and the Injection Capacity during the withdrawal stage based on the technical capacities of the system to reverse its flow without limiting the Performances available to the other Shippers.

However, once the need to reverse the flow is established following the scheduling of the Shippers and the set-ups of the sites have been physically determined, the Storage Company, in agreement with the criteria pursuant to paragraph 6.6.6 does not allow changes in the scheduling of the Shippers during the renomination cycle for the same cycle that involves an additional revision of the aforesaid set-up, in actual fact allowing only virtual reverse flows.

The capacities are made available and assigned according to the methods described in the following chapters.

2.4.4.7. *Additional injection capacity*

If the trend of the injection peak availability already assigned during the Injection Period shows an availability of PI on a continuous basis in addition to what is stated in paragraph 2.4.4.2, the Storage Company makes additional PI available to the Shippers by modifying the adjustment coefficients, without prejudice to the need to protect correct use of the reservoirs.

2.4.4.8. *Additional withdrawal capacity*

If the trend of the withdrawal peak availability already assigned during the Withdrawal Period shows an availability of PE on a continuous basis in addition to what is stated in paragraph 2.4.4, the Storage Company makes additional PE available to the Shippers according to the methods stated in paragraph 3.2.1.3, without prejudice to the need to protect the System.

2.4.4.9. *Capacity on interruptible basis*

If capacities remaining after the continuous capacities scheduled by the Shippers of allocated through the procedures explained below in paragraph 5.9.2.1 on a monthly, weekly or daily basis, first session, become available, the Storage Company offers these capacities on an interruptible basis, pursuant to paragraph 3.2.2.2 below, within the scope of the competitive procedures described in paragraph 5.9.2.1, second session and, only on a daily basis, of the overnomination mechanism described in paragraph 3.2.1.2.

2.4.5 Use profiles and adjustment coefficients of the IP and WP Performances

As already pointed out in the forgoing paragraphs, the dynamic evolution of the WPs and IPs mainly depends on the following factors:

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

In order to optimise the System while at the same time guaranteeing maximum flexibility to the Shippers, the Storage Company defines for the Modulation Service Performances:

i. Use profile and adjustment coefficients of the storage capacity in the injection stage and the relevant applicability interval;
ii. Use profile and adjustment coefficients of the storage capacity in the withdrawal stage and the relevant applicability interval.

The Storage Company does not define use profiles and/or adjustment factors or the operational balancing service, considering its different operating procedures and functionality, while it defines - but only for the injection stage - the use profiles for the hydrocarbon storage service in order to guarantee total filling of the assigned space.

2.4.5.1. *Use profile, adjustment coefficients of the Storage Capacity and the relevant applicability interval in the injection stage for the modulation storage service*

The storage company defines the use profile and adjustment coefficients of the storage capacity for the injection stage in connection with the characteristics of its storage system, the schedules for periodic checks and the need to restock the reservoirs while ensuring appropriate flexibility to the shipper.
These parameters are obtained by assuming total emptying of the S_{MODP} and based on the following criteria:

- Trend of the historic injected quantities of the previous Thermal Years
- Actual storage of the previous thermal year
- Volume to inject in order to guarantee the restocking of the reservoir, including any strategic storage volume;
- Maximisation of the injection capacity in the periods of greatest need for the Shippers, in observance of the technical constraints;
- Guarantee that the assigned space is filled.

The use profile defines the minimum and maximum stock allowed to the Shipper at the end of each month of the injection stage, according to the capacity assigned to the shipper. They are represented by percentage values (Gmin% and Gmax%) that when multiplied by the assigned Space determine the stock interval by which the Shipper should find itself at the end of each month.

The adjustment coefficients and their intervals of applicability on the other hand represent the multiplicative factors to apply to the CI_{MODP} and the CI_{MODU} assigned in order to determine the maximum available Injection Performance (IP_{MODP} and IP_{MODU}) of the system on every service day.
The adjustment coefficients are such as to reflect the decreasing trend of the PI_{MODP} and the IP_{MODU} based on the total draw-off, and any reductions of Performance consequent to the Major Maintenance Operations.

At this time Edison Stoccaggio makes available only the Peak Modulation Service[1].

The performances associated with the injection capacity for the peak service during the injection stage are determined for each shipper as the amount of total injection performance available for the same services corresponding to the following ratio:

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

where:

[1] Reference is made only to this service below

- $G_{max\ u,k}$ is the maximum stock of Shipper u at the end of month k of the injection stage determined based on what is established in paragraph 8.4.2 below;
- $G_{i\ u,k}$ is the minimum stock, determined based on what is established under paragraph 8.4.1 below, or the actual stock of Shipper u at the beginning of month k of the injection stage, whichever is greater;
- $G_{max\ s,k}$ is the maximum stock planned in connection with the total capacities available to the shippers based on the relevant use profiles at the end of month k;
- $G_{min\ s,k}$ is the minimum stock planned in connection with the total capacities available to the shippers at the beginning of month k based on the relevant use profiles.

In order to determine term $G_{i\ u,k}$ for the month of April, the minimum stock on the basis of what is established in paragraph 8.4.1 below will take into account the actual stock of the system at 31 March.

If in a month k capacity has been assigned to a Shipper u as part of different product allocation procedures with seasonal or monthly injection, terms $G_{max\ u,k}$ and $G_{i\ u,k}$ are determined based on the maximum and minimum stocks referring to the capacities assigned in the various procedures.

Any available performances exceeding those assigned to the totality of the shippers as determined above are assigned to the shippers pro quota on the basis of ratio Ru.

Therefore, the distribution to each shipper of the injection capacities of the system possibly exceeding the total of the capacities assigned to every single shipper through parameter Ru is carried out on the first day of each month of the injection stage with a pro quota criterion based on the single Rus.

$IP_{MODP,k}=IP_{MODP}*Ru_k$

It is understood that if the remaining Space of the Shipper is less than the available Injection Capacity, the Injection Capacity is equal to the remaining Space.

The total Injection Capacity available is equal to the product of the total Injection Capacity assigned for the Modulation Service and the Adjustment Coefficient. This latter is the coefficient, falling between zero and one, that is variable inversely of the total System stock according to what is published and updated by the Storage Company on its website.

The use profiles, draw-off intervals and corresponding adjustment coefficients are published on the Website of the Storage Company and are updated according to the methods described in paragraph 2.4.6 below.

If the Shipper of the Modulation Service has sold injection performance under the procedures explained in paragraph 5.9.2.1, its daily Injection Performance will be reduced by the portion sold.

2.4.5.2. *Use profile, adjustment coefficients of the Storage Capacity and the relevant applicability interval in the injection stage for the Modulation Storage Service with capacity assignment on a monthly, weekly and daily basis.*

The Injection Capacity assigned as part of the procedures explained in paragraph 5.9.2.1 does not sustain changes in connection with the trend of the Shipper's Injection or Withdrawal.

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

2.4.5.3. *Use profile, adjustment coefficients of the Storage Capacity and the relevant applicability interval in the Withdrawal stage for the modulation storage service*

The storage company defines the use profile and adjustment coefficients of the storage capacity for the withdrawal stage in connection with the characteristics of its storage system, ensuring appropriate flexibility to the shipper.
These parameters are determined on the assumption of complete filling of the assigned Space and on the basis of the following criteria:

- Keeping the maximum withdrawal capacity available as long a time as possible through hydrocarbon optimisation;
- Guarantee of maximum continuity of the available performances;
- Complete emptying of the assigned Space, except for the S_{STR};
- No change to the Major Maintenance Operations schedule.

The use profile defines the minimum stock allowed to the Shipper at the end of each month, in proportion to the assigned S_{MODP}.

The adjustment coefficients and their intervals of applicability on the other hand represent the multiplicative factors to apply to the CE_{MODP} assigned in order to

determine the maximum Withdrawal Performance (WP_{MODP}) available to the Shipper on every day of the period the assigned capacity is valid.
The adjustment coefficients are such as to reflect the decreasing trend of the WP_{MODP} based on the total draw-off and that of each Shipper, and any reductions of Performance consequent to the Major Maintenance Operations.
The use profiles, draw-off intervals and corresponding adjustment coefficients are published on the Website of the Storage Company and are updated according to the methods described in paragraph 2.4.6 below.

If the Shipper of the Modulation Service has sold withdrawal performance under the procedures explained in paragraph 5.9.2.1, its daily Withdrawal Performance will be reduced by the portion sold.

2.4.5.4. *Use profile, adjustment coefficients of the storage capacity and the relevant applicability interval in the Withdrawal stage for the modulation storage service with capacity assignment on a monthly, weekly and daily basis.*

The Withdrawal Capacity assigned as part of the procedures explained in paragraph 5.9.2.1 on a continuous and interruptible basis does not undergo changes in connection with the trend of the Shipper's Withdrawal or Injection.

It is understood that this capacity is zero if the Gas owned by the Shipper is totally used. It is also understood that in the case of Withdrawal of a quantity of Gas by the Shipper greater than the Gas in the System that it owns, the prices set forth in chapter 8 below are applied to all surplus quantities withdrawn.

2.4.6 Revision of the use profiles and adjustment coefficients

The Storage Company conducts the simulations for the following Thermal Year in such a way as to allow all necessary elements to be published by 1 February before the start of the same Thermal Year.

Bearing in mind the possible changes, also major, tied to the final part of the Withdrawal Stage and to the possible changes in the capacities made available pursuant to forgoing paragraph 2.4.3.3, the simulations for the following Injection Stage can be updated by the middle of March in order to permit adequate seasonal scheduling to the Shippers.

For these same reasons the Storage Company checks consistency with the parameters used for defining the initial simulations by the middle of October by - for example, if the System is not totally filled - updating in order to get better operational scheduling by the Shippers.

This consistency check is carried out also based on a joint technical analysis with the transport companies.

Since the adjustment coefficients and their intervals of applicability are also heavily influenced by the Major Maintenance Operations schedule, as defined in paragraph 13.2 of the chapter “Scheduling and Managing Maintenance Operations”, and by the response of the reservoir in terms of incremental performance available as a result of these operations, the Storage Company reserves the right to change them if the above-mentioned Major Maintenance Operations or performances change compared to what is planned at the time they are determined. The aforesaid coefficients will be changed to such an extent as to however guarantee an injection or withdrawal profile that allows at least the times for the withdrawal and injection stages planned by the previously effective coefficients and the capacity value CE_{MODP} assigned to be kept equivalent.
The changes to the adjustment coefficients will be notified to the Shipper by registered letter, sent in advance by email and published on the website at least 15 days before their application.

The Storage Company also reserves the right to change the Use profiles monthly if the actual trend of the storage or draw-off are not consistent with the use profiles in effect and with the Performances available.

When redefining use profiles, adjustment factors and their validity interval, the Storage Company bears in mind the needs of the Shippers by implementing all actions that can guarantee maximum System flexibility.

2.5 INFORMATION PUBLISHED ON THE WEBSITE

The Storage Company annually publishes and updates on its Website:

a. The geographic representation of the storage facilities, with their locations;
b. The schematic representation of the storage facilities;
c. The list of scheduled upgradings and divestitures;
d. The Point of Entry on the national gas pipeline network with the interconnected transport company specified.

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 relating to the storage facilities it owns;
g. The technical-management constraints arsing from the Major Maintenance Operations;
h. The use profiles, adjustment factors and relevant applicability intervals.