

Feasibility of Creating Gas Underground Storage in Frame Gas Development of The Bolivarian Republic of Venezuela.

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The Bolivarian Republic of Venezuela under the gas development of the nation's main philosophy the internal development of the nation, the welfare of its people, environmental conservation and strengthening of Latin American integration, all on the basis of being reliable and secure gas supplier. Venezuela has today with large proven reserves of natural gas ranking as the country with the eighth largest proven reserves of natural gas and the first in Latin America.

Proven gas reserves in Venezuela totaled 151 Billion Cubic Feet of gas (PCBs) and have a volume of 40 billion possible reserves and resources base about 196 billion PCBs, to a volume of reserves 427 trillion cubic feet. According to the National Gas Entity (Enagas), so our country will go from eighth to third place as the country with the largest gas reserves in the world , becoming the first in Latin America (Figure 1).

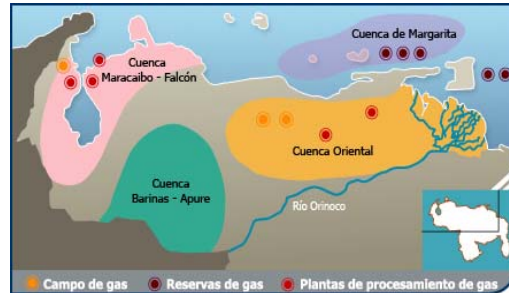


Figure 1- Location of Major Gas Reserves in the Bolivarian Republic of Venezuela.

Generate sustainable and harmonious development in time the nation did everything necessary to make a study of gas transport systems based on growth plans in the nation.

As part of the study on the gas development of the nation has analyzed the technical feasibility of the creation of Underground Storage of Gas (ASG) that position to Venezuela as a reliable and secure supplier nationally and internationally.

This studio gives an overview of the only study of its kind undertaken by the Venezuelan state company PDVSA in the Bolivarian Republic of Venezuela on the feasibility of creating Underground Storage of Gas gas

development as part of the nation in the medium and long term.

Importance of to study the Creation of Underground Gas Storage in the Bolivarian Republic of Venezuela.

The importance of the study is determined by the need to maintain safe conditions for gas supply to customers. The absence of the ASG is reflected in the technological indices of operation gas supply system of the country. The safe and stable supply of gas to domestic and international market is the necessary condition of normal operation and development of the state's economy and political stability of society . The creation and development capabilities of ASG is intended to ensure the functioning of the economy, ensuring the export of gas to form the necessary conditions for the international sale of gas.

Methodology to justify the necessity to create gas reservoirs in Venezuela to cover fluctuations in gas consumption in the different variants of the development of the Gas Industry.

Develop draft technical feasibility of creating ASG in the Bolivarian Republic of Venezuela merited the

analysis of the structure of gas consumption in Venezuela.

To determine the required volume of gas reserves in the ASG by variant P - 50 Development of Gas Industry and justify the geographical location of the stores, it was necessary to analyze the spatial structure of the demand for gas. According to the forecast schemes gas demand as the peak and moderate variant, technical features, existing and planned transport of gas, were determined the necessary volumes of gas reserves by province (Figure 2).



Figure 2-. Division Venezuela commercial regions.

In this section the fundamental sources of energy were analyzed. It was determined the increased use of natural gas in the consumption structure of the country and this goal was to maintain a safe and stable supply of gas to customers in the country. The second aspect of the data was

analyzed gas production in the country, determining the irregularities of the main production areas of the country. Comparing production rates of oil and gas was performed. The third aspect studied contains the analysis of the use of the capacity of the Gas Transportation System of Venezuela, establishing indices related to the use of the capacity of the gas transport system. Variations in the levels of transport were determined by gas consumption rate, and not the pattern of gas production. The fourth aspect in the development of the study was based on the analysis of the gas market in Venezuela. Behavior of fluctuations in gas consumption and its parameters are also established. The fifth aspect provides the analysis of the balance of production and distribution of gas. Consistent with the structure formed gas balance was established the effect of gas venting to the atmosphere, which is a variable to be analyzed to minimize their effect and thus its impact on the environment.

Justification of the necessity to create the active volume of gas to cover fluctuations in gas consumption in the country.

After analyzing all the information were determined prognostic schemes gas

demand fluctuations and rates of consumption by 2030 according to variants and moderate peak. The analytical evaluation of the information provided led to the conclusion that the volume of irregular gas consumption in the country.

In Venezuela preference in the choice of objects for creating an ASG is given first to the depleted gas and condensate and enter distributed throughout the East of the country mainly. The United Anzoategui, Bolivar , Delta Amacuro , Monagas , Nueva Esparta, Sucre are located in the eastern region of the country and it is important to note that this region has the highest Clients gas consumption (Figure 3).



Figure 3 - East Region of Venezuela.

Secondly justified the need for an ASG in the central region of the country to cover fluctuations in gas consumption in the Central region.

The Central region includes three states: Guárico , Miranda, Vargas and

Dtto.Capital , where is located the capital - Caracas (Figure 4).



Figure 4 - Region Centre of Venezuela.

This region consumes 12.44 % of the gas in the Republic. All three states of the region have a highly developed electricity industry , ensuring electricity to the city of Caracas. In this sense, we conclude need to create the gas reserve , which would ensure the operation of the gas transmission facilities and power generation .

Similarly analyzed create an ASG and cover fluctuations in gas consumption in the Center-West. Center-West region has the States of Amazonas, Apure, Aragua, Barinas, Carabobo, Cojedes, Lara, Yaracuy, Portuguesa (Figure 5).



Figure 5 - Central-Western Venezuela

The largest volume of gas is consumed by customers of Carabobo State. Customers here are concentrated in different sectors like Oil, Power, Petrochemical, Steel Industry and Manufacturing.

It combined the study of the West Central region was analyzed to create the active gas volume required to cover the Western region fluctuations in gas consumption in the region which is composed of the Falcón, Táchira, Zulia, Merida, Trujillo, where are the Electric Customers sectors like Cement, Petrochemical and Manufacturing. This region in the future can consume up to 25% of the gas producer (Figure 6).



Figure 6 -Region Western Venezuela.

The main irregularities are the industrial centers in the states of Zulia, Falcón and Táchira. The irregularity of gas consumption in those states ranges from 5.4 to 6.6% depending on the variant peak until 1.2 - 1.6% - according to the moderate variety.

Types Studied ASG.

Criteria for the selection of fields to create ASG based on features of the geological structure of the territory of Venezuela and industrial geological feature of objects.

The creation of an underground gas storage is a multistage process, the last stage is the storage and operation of a gas artificially created.

The choice of the field to create an ASG and its construction are determined by the need for gas reserve region.

They highlighted three types of gas storage that were reviewed during the

course of the study, according to their final destination:

- Main ASG
- Storage peak.
- Storage using associated petroleum gas.
- The ASG is created under:
 - Reservoirs gas and condensate and gas;
 - Reservoirs oil;
 - Aqueous Structures;
 - Layers of rock salt;
 - Minas.

Making the choice to build an object where ASG in Venezuela was based on the following criteria:

- Optimal location of the object in terms of gas customers and the gas transport system;
- Presence trap, sufficient capacity to ensure safe storage of the volumes required for gas reserves;
- Presence of a reservoir with high filtration properties which ensure high daily gas collection;
- Reservoir for allowable depths from the technical economic sense;
- Presence of a sufficiently tight seal to isolate capacity storage object underlying gas permeable layers;

- Tightness of all drilled wells (active and abandoned) that cross the reservoir.

Criteria for Selection of Reservoirs for feasibility study of creating ASG in Venezuela.

Major geological criteria considered for selection of the reservoirs to be intended as ASG property was reservoir filtration. From the viewpoint of the lithological composition of the most prospective reservoirs are located in terrigenous rocks horizons as carbonaceous rocks are characterized by the presence of cracks which can serve as a channel for gas migration out of the boundaries of the trap. Global experience in creating ASG shows that the main criterion is the impermeability of the object. Seals (screens) fluid must guarantee insulation of the object of operation under conditions of increased interstitial pressure. The impermeability of the object to reveal storage unpleasant consequences such gas injection and the possible migration of gas to underlying and overlying horizons.

The ASG should be create to 450-2500 meters depth. Keep in mind that how deep the object is better the relationship between the working gas and the buffer

gas, the easier it will be to control the tightness of the object, the higher the productivity of the wells, with this the wells cost will be higher. The optimum depth yacencia of objects is 1000 - 2000 meters.

The advantages of creating ASG based gas fields and condensate and gas are:

- Well-study of the object.
- Tightness proven geological object.
- Infrastructure.
- Ability to use old wells.

Usually has lots of information on depleted fields and geological structure. Depleted fields have passed the stage of operation and as a rule are characterized by parameters sufficient filtration layer (pore pressure, temperature, production characteristics of wells, depression, escape character from water, sand, reservoir operating regime, etc).

We must take into account some additional requirements in choosing objects based ASG gas fields and condensate and gas

- Absence of aggressive components (CO₂, H₂S) in the gas.
- Original booking (recovered) optimal gas in the reservoir.
- Isolation reservoir of underlying and overlying layers and aquifers productive horizons.

-Tightness of old wells (exploration, operation, injection, etc.) and the possibility to use them for the purposes of ASG.

The tightness of storage is very important in the creation of ASG. In the process of operation ASG wells are the main constructions by which injection and gas collection is performed, are the primary means of control and safety technology of production over environmental protection.

In choosing the object to create a ASG in depleted preference is given to the objects that are opened by the minimum number of wells. Also you should study carefully the technical condition of the wells in all categories that work as well as abandoned. Requirements of geological objects intended for the creation of ASG based oil fields:

- Presence of a layer of gas in the field.
- The oil should be light and low viscosity;
- Lack of tectonic dislocations;
- Fairly large reservoir thickness.

The evaluation of seal tightness in creating ASG in oil fields is a very important task. On one hand, the presence of an oil field shows that the site has a seal on the other hand, in the

process of creation and operation of ASG in depleted oil high interstitial pressure in many cases exceeds the hydrostatic, this requires greater tightness of sediments located above the gas field. The presence of tectonic dislocations passing through the reservoirs and seals oil deposits can lead to direct losses of gas, eg exhaust gas overlying horizons.

Thus, the choice of object to create the ASG was given preference to oil or gas fields where the gas layer has simple structure, the deposits have a network of wells and the reservoir has high filtration properties and is isolated by an impermeable layer.

The choice of objects to create ASG must necessarily be accompanied by a general analysis of the geological structure, from this analysis the possibility of creating the ASG in the chosen region is determined.

Justification of the categories of gas reserves in terms of the operation of the Gas Transportation System of Venezuela.

The Underground Storage of Gas (ASG) are the basic and most economical means of booking and secure supply of gas.

The volume of gas in the ASG is determined due to their different scopes in: creating strategic or operational reserve.

The operational gas volume conditions is intended to Venezuela: the creation of commercial reserves, compensation for partial delivery of gas in case of failures in the Gas Transportation System (STG), potential plant shutdowns for maintenance equipment, operation flexibility in the production of hydrocarbons, environmental conservation and to ensure future gas exports.

More erratic gas consumption is typical for older Domestic customers: Electric, Petrochemical, Iron and Steel and Manufactures. So are the sectors that form the basic irregularity of gas consumption, which in turn could reach up to 76.5% of total gas consumption.

The analysis of historical data for gas consumption by sector showed that the process of irregular gas consumption is oriented to the market situation. Thus, two variants of gas consumption were examined: peak and moderate variant to determine the potential volume fluctuations in the future.

Variant Peak - displays the behavior of the irregular variant with high gas consumption in the future; Moderate variant - considered an average value of gas consumption irregular for months for a historical period.

The schemes examined gas consumption volumes allowed to determine the necessary backup gas sales, based on two optimal variants: moderate peak.

As a rule, gas exporter ensures reliable supply of gas to the border. The necessary reserve of gas is determined by considering the possible errors in the energy balance of the country and secure supply of gas to the main customers, with aim of eliminating lack of energy resources.

Conclusions

1.-Venezuela is a big producer and consumer of hydrocarbons with excellent positioning worldwide.

Predicted changes are currently facing with increased consumption of natural gas as fuel in various industrial processes aligned with the development and balance of resources. This condition requires performing projects in the medium

and long term to ensure the supply of gas to customers in the domestic market of the country and to strengthen Venezuela's position in the global energy market.

The feasibility of existence and availability of Underground Gas Storage strengthen the supply of gas to customers in the domestic market of the country and secure gas exports abroad. Such condition PDVSA GAS positioned internationally as a reliable partner, which increases the energy security of the country and secure compliance with the obligations of export of gaseous hydrocarbons.

2.- Once analyzed the gas demand forecast as the P-50 variant of the development of the Gas Industry in Venezuela and creating different scenarios of gas consumption: the peak; values based on fluctuations in gas consumption during the historical period, and moderate; determined by the average value of gas consumption per month during the historical time period considered: for determining the necessary volumes of gas reserves because of its scope and objectives, and conclude the following:

2.1. The Underground Gas Storage are the main and most effective technical means to ensure the supply of gas to customers.

2.2. The required volume of gas reserves in Venezuela forms of commercial reserves, compensation for partial delivery of gas if stoppages and breakdowns and planned maintenance (unplanned), the country's strategic reserve and reserve securely export.

2.3. Values of harvesting gas supply to the Customer fully insure the supply of gas in case of breakdowns, and gas supply due to market conditions.

2.4. Existing Gas Transportation System, considering the future expansion and new projects are sufficient to supply gas to the ASG while no limit to Customers located in different regions of the country and ensure the supply of gas ASG Customers of the Central, East and West regions of the country in the event of unforeseen circumstances beyond its control.

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Bolivarian Republic of Venezuela
aligned gas development in the
nation.

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