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Simulation of the impact of boosting method on gas reservoir recovery (TAGS) at Brides field, Gassi Touil Region.

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شكر وتقدير لعمال سوناطراك البواش 🕵 إلى عمال سوناطراك الكرام، يسعدنا، ونحن نختم هذا العمل، أن نتوجه إليكم بوافر الشكر والتقدير، عرفاناً بجميل ما قدمتموه لنا من عونٍ وسندٍ خلال مسيرة إنجازه لقد كنتم خيرَ رفقاءٍ دربٍ، وسندٍ قويٍّ، شاركتمونا بِخِبراتِكم الواسعة وعلمِكم الغزير، مُثْرِينَ إيانا بِمَعَارفَ شاملةٍ أفادتنا في تكوينِنا وتطويرٍ محاراتِنا لا يسعنا إلا أن نعترف بأنّ هذا العمل لم يكن ليُكتمل بِهَذِهِ الصورةِ اللائقةِ لولا جمودكم الجبّارة وتفانيكم الصادق. فقد أبديتمُ صبرًا جميلاً وتواضعًا مُقَدّرًا في تعاملكم معنا، تمّا زادَ من شعورِنا بالامتنانِ والتقديرِ لكم. إنا لن ننسى أبدًا وقوفكم معنا في كلّ خطوةٍ من خطواتِ هذا العمل، ودعمكم المتواصل لنا. فكنتم خيرَ سندٍ لنا، وخيرَ عونٍ على إنجازِهِ بِأعلى دقةٍ واتقان جزيل الشكر والتقدير لكم، أيها العمال البواسل، على ما بذلتموه من جمدٍ وعطاءٍ مخلص، وعلى ما قدمتموه لنا من دعم معنويٍ ومادي لا يُقدر بثمن يدلك لاننسى ان نخصص شكرا لكل من الافاضل بوحجة محمد,عماد هتهات,درويش عبدالرحيم,عبو احمد وطارق بوغباش. مع خالص التمنيات لكم بالتوفيق والسداد في مسيرتكم المهنية المُشرِّفهُ



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الى ابي نور عيناي وكل عائلة حود مليسة ، لعويسات وبوعبيد .

الى أعظم مهبات الله لي في مذه الحياة ، وسبب وجودي والاستمرار فيها ، وفي وسط العتمة نور، حتى الحروف لن تصف شروق شمس بجمال ابتسامتك ولا غروبها بدونها "أمي". الى اختاي اللتان لم تنجبهما امي خلود واسراء .

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Abstract

In oil and gas production, Boosters play a crucial role in ensuring efficient transport of well fluids from the reservoir to processing facilities. Our research involves studying the impact of this method on the production of 7 wells in the Brides field, Gassi Touil region. This study is based on the analysis and interpretation of modelling results and production predictions using the MBAL and PIPESIME software. Our findings demonstrate that implementing the booster will result in a significant increase in gas and condensate flow rates. Furthermore, our economic assessment reveals an exceptionally short payback period of around 41 days into the project.

Keywords:

Booster, modelling, predictions, Brides field, MBAL software, PIPESIME software.

Résumé

Dans la production pétrolière et gazière, les Boosters jouent un rôle crucial en assurant un transport efficace des fluides de puits du réservoir aux installations de traitement. Notre recherche consiste à étudier l'impact de cette méthode sur la production de 7 puits dans le champ Brides, région de Gassi Touil. Cette étude s'appuie sur l'analyse et l'interprétation des résultats de modélisation et des prévisions de production à l'aide des logiciels MBAL et PIPESIME. Nos résultats démontrent que la mise en œuvre du surpresseur entraînera une augmentation significative des débits de gaz et de condensats. De plus, notre évaluation économique révèle un délai de récupération exceptionnellement court d'environ 41 jours après le début du projet.

Les mots clés :

Booster, modélisation, prédictions, champ de Brides, Logiciel MBAL, Logiciel PIPESIME.

مستخلص

في إنتاج النفط والغاز، تلعب المعززات دورًا حاسمًا في ضمان النقل الفعال لسوائل الآبار من المكمن إلى مرافق المعالجة. يتضمن بحثنا دراسة تأثير هذه الطريقة على إنتاج 7 آبار بحقل بريداس منطقة قاسي الطويل. اعتمدت هذه الدراسة على تحليل وتفسير نتائج النمذجة وتنبؤات الإنتاج باستخدام برنامج MBAL وMBAL وPIPESIME. توضح النتائج التي توصلنا إليها أن تنفيذ المعزز سيؤدي إلى زيادة كبيرة في معدلات تدفق الغاز والمكثفات. علاوة على ذلك، يكشف تقييمنا الاقتصادي عن فترة استرداد قصيرة للغاية تبلغ حوالي 41 يومًا من بدء المشروع.

الكلمات المفتاحية:

المعزز، النمذجة، منطقة بريداس، التنبؤ بالإنتاج، برنامج MBAL، برنامج PIPESIME.

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Symbols and Abbreviations

n_p: Moles of gas produced. **n**_i: Moles of gas initially in the reservoir. **n**_f: Moles of gas remaining in the reservoir. **P**_i: Initial reservoir pressure. **G**_p: Cumulative gas production, **scf. P** : Current reservoir pressure. V: Original gas volume, ft3. **z**_i: Gas deviation factor at pi. **z:** Gas deviation factor at p. T: Temperature, °R. **W**_e: Cumulative water influx, **ft3**. **W**_p: Cumulative water production, **ft3**. **G:** Initial gas in place (**SCF**). q: Flow rate. **Pwf**: Bottomhole flowing pressure. Pwh: Wellhead pressure. ΔP : Pressure drop in each segment. q_g : Flow rate, Mcf/D. k: Permeability, md. h: Net vertical thickness, ft. $\overline{\mathbf{p}}_r$: Average formation pressure (shut-in BHP), psia.

p_{wfs}: Sandface flowing BHP, **psia**.

μ: Viscosity, **cp**.

T: Temperature, °**R**.

Z: Supercompressibility, dimensionless.

r_e: Drainage radius, **ft**.

- **r**_w: Wellbore radius, **ft**.
- **S:** skin factor, dimensionless.

MF: Manifold.

HP: High pressure.

LP: Low pressure.



Introduction



Introduction

Natural gas is a clean-burning source of energy extracted from geological formations. It is widely used for various purposes such as heating, cooling, electricity generation, and the production of essential materials like steel and concrete. The natural gas industry is an important contributor to Algeria's Gross Domestic Product (GDP). In 2019, natural gas rents in the country accounted for approximately 2% of the country's economy.

Oil and gas companies have sought to maximize the recovery of the reserves in place and to extend the life of the mature oil and natural gas sites to meet the global demand for these fossil energies, which constitute almost all of the energy consumed worldwide.

Enhancement of the production of oil and gas is considered a must during the lifespan of any hydrocarbon reservoir, as their production naturally declines over time. Thanks to significant technological advancements, the petroleum industry has introduced various methods to increase the total recovery of oil and gas. These methods include artificial recovery techniques such as gas lift, CO2 injection, as well as stimulation methods. Additionally, it is also important to take into consideration other different elements that may cause a decline in production such as the location, and operating environment of the wells. Production optimization techniques may not always be a sufficient solution in these cases.

In our research, we are focusing on the Boosting technique. The compression unit "Booster", is a multiphase pressure boosting technology, is designed to increase the pressure of the well fluids (oil, gas, and water mix) ensuring efficient transportation from the reservoir to processing facilities. This boosting system can offer a cost-effective solution to well intervention and contributes to the recovery of more hydrocarbons by overcoming pressure drops in pipelines, ultimately prolonging the life of the hydrocarbon field.

We aim to achieve the following objectives in our study:

- Identifying the "Boosting" technology and its various applications on the production system and discussing the potential improvements that this technique could bring.
- Employing MBAL software to model reservoirs.
- > Utilizing PIPSIME software to model the Boosting unit production system.
- Optimizing the flow and analyzing the impact of the Booster on the overall system and future production.

Our research consists of 4 chapters. The first chapter is a general overview of the Gassi Touil region, where our study took place. In the second chapter, we delve into the concept of production prediction and the general knowledge required to realize our study. The third chapter discusses the criteria for selecting the 7 candidate wells that have been chosen to be boosted and provides a detailed description of the Boosting unit proposed. The fourth and final chapter will contain the result of our research, detailing the use of MBAL and PIPESIM software to model and predict the potential outcomes of implementing a Boosting unit on the candidate wells.



General Information on Gassi Touil Region



I.1 Sonatrach Production Division (DP)

Sonatrach is the Algerian national company responsible for research, production, pipeline transportation, processing, and marketing of hydrocarbons and derivatives. It's also involved in other sectors like power generation, renewable energies, and desalination. Sonatrach operates in Algeria and around the world.

It's the leading company in Africa and holds a prominent position globally. Its total production (all products combined) was 191 million TEP (Tonnes Equivalent Pétrole) in 2015. Its activities contribute to about 31% of Algeria's Gross National Product (GNP). Sonatrach employs 120,000 people across the group.

Sonatrach is divided into four Activities: Exploration & Production, Downstream, Pipeline Transportation, and Marketing. The Production Division (DP) is an integral part of the Exploration & Production Activity.

I.2 Presentation of the Gassi Touil Site

The Gassi Touil Regional Directorate is one of ten Regional Directorates that constitute the Production Division of the Exploitation Production branch / Exploration & Production Activity of the Sonatrach group.

Petroleum, gas, and dry gas extracted from deposits in the perimeters of Brides, Nezla (North and South), Gassi El Adem, Gassi Touil, Toual, Hassi Touareg (North and South), Hassi Chergui (North and South), and Rhourd El Khelf. [1]

The Regional Directorate has various base facilities, including:

- Two production units (one for crude oil treatment and one for gas treatment).
- Oil and gas fields.
- An agricultural area (launched as part of the Saharan agriculture development policy).

The Gassi Touil region is situated in the Ouargla wilaya, approximately 1000 km from Algiers and 150 km southeast of Hassi Messaoud. It encompasses an area of roughly 170 km in length and 105 km in width. [2]

a) Geographical Coordinates:

X: 06° 28' 7'' E

Y: 30° 31' 0'' N

b) UTM Coordinates:

- X = 257,100
- Y = 3,378,550



Figure I.1: Geographique localisation Gassi Touil region. [3]

I.3 History of Gassi Touil region

The Gassi Touil region is composed of several fields, with the main ones being:

• Gassi Touil (GT), discovered in 1961, confirming the presence of oil and gas

with 80 gas wells drilled.

- Nezla Nord (NZN), discovered in 1958, indicating the presence of oil and gas with 10 oil and gas wells drilled
- Nezla Sud (NZS), discovered in 1958, revealing the presence of gas with 30 gas wells drilled
- Hassi Touareg (HTG), discovered in 1958, confirming the presence of gas with 13 gas wells drilled
- Hassi Chergui (HC), discovered in 1962, confirming the presence of oil with 10 oil wells drilled.
- Gassi El Adem (GEA), discovered in 1967, with 9 gas wells drilled.

The fields under development are:

- **Brides (BRD)**, discovered in 1958, indicating the presence of dry gas with 12 gas wells drilled.
- Toual (TOU), discovered in 1958, revealed the presence of gas and condensate with 32 gas and condensate wells drilled. [1]



Figure I.2 : The positioning of the Gassi Touil region fields.. [4]

Field	Reservoir
BRIDES	Q.H
BRIDES	T.A.G.S
BRIDES	T.A.G.S
BRIDES	T.A.G.S
GASSI EL ADEM	Q.H
GASSI TOUIL	T.A.G.S
GASSI TOUIL	T.A.G.I
HASSI CHERGUI	T.A.G.S
HASSI CHERGUI	T.A.G.S
HASSI TOUAREG	T.A.G.S
HASSI TOUAREG	T.A.G.S
NEZLA	T.A.G.S
NEZLA	Q.H+G.O+T.A.G.I
NEZLA	T.A.G.S
TOUAL	T.A.G.I
TOUAL	T.A.G.S

able I.1: The reservoirs of	Gassi Touil region fields. [5]
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I.4 Brides Field Overview

The Trias Argilo-Gréseux Supérieur (TAGS) formation in the Brides region can reach thicknesses exceeding 150 meters in some places. However, only the basal 40 to 50 meters show potential reservoir intervals, characterized by core samples with porosities ranging from 2 to 16% and variable permeabilities of 0.1 to 177 md. Its lateral extension in the Brides region is estimated to be hectometric (on the scale of hundreds of meters). The results of the Brides exploration wells (BRD-1, 2, 3, 4, 5, and 6) have revealed a significant gas condensate deposit based on the Gas-Water Contact (GWC) located at -3222 meters TVDSS (True Vertical Depth Subsea) in the TAGS reservoir. **[6]**

- **BRD 1 (1963):** The first well drilled in the BRD area, BRD 1, encountered gas within the TAGS formation in 1963.
- BRD 2 Drilled in 1971, BRD 3 (1974), and these three wells, drilled between 1987 and 1995 BRD 4 (09/87 01/90), BRD 5 (02/92 01/94), and BRD 6 (05/94 08/95)

There are three TAGS reservoirs in BRIDES:

• TAGS MAIN (BRD1, BRD12, BRD13, BRD14, BRD15).

- TAGS WEST (BDSN-2)
- TAGS NORTH (BDSN-1)

I.4.2 Coordinates

Geographic Coordinates:

- X: 6°55'00" to 7°05'00"
- Y: 30°35'00" to 30°21'00"

UTM Coordinates:

- X: 308 200 to 315 600
- Y: 3 394 500 to 3 378 300



Figure I.4: Geographique situation of Brides field. [1]

I.5 Lithological description of the Brides Field

- The Brides region is located in the northwestern part of the Triassic Southeast province.
- This fault has a strong vertical throw at the Ordovician level and attenuates rapidly upwards in the series.
- At the Ordovician level, the structure, of Aptian age, seems to have been strongly reactivated after the Senonian.
- The stratigraphic column of Bridès presents terrains from the Cenozoic, Mesozoic and Paleozoic eras that would rest on a Precambrian basement.
- The Cenozoic is represented by the Miopliocene.
- The Mesozoic is composed of Cretaceous, Jurassic and Triassic terrains and rests unconformably on the Lower Paleozoic terrains which are present at Bridès through the Silurian formations, and partially of the Ordovician.
- The Cambrian would be underlying the Ordovician. [1]



Figure I.5: Lithological Description Brides Field. [4]



Chapter II

Production Prediction Methods



II. Introduction

Each reservoir is composed of a unique combination of geometric form, geological rock properties, fluid characteristics, and primary drive mechanism. Although no two reservoirs are identical in all aspects, they can be grouped according to the primary recovery mechanism by which they produce. It has been observed that each drive mechanism has certain typical performance characteristics in terms of:

- Ultimate recovery factor.
- Pressure decline rate.
- Gas-oil ratio.
- Water production.

The term "primary recovery" refers to the production of hydrocarbons from a reservoir without the use of any process (such as fluid injection) to supplement the natural energy of the reservoir. **[7]**

We must make a distinction between Conventional and Unconventional Gas Reservoirs.

- Conventional gas reservoirs are reservoirs with sufficiently high permeability to allow for production using conventional well technologies.
- Unconventional reservoirs are reservoirs with low permeabilities that require special production technologies that allow for economic recoveries of gas (Typically, permeability less than 0.1 md). These unconventional reservoirs include:
 - shale gas and shale oil reservoirs.
 - coal seam methane reservoirs.
 - tight oil and gas sandstones or carbonates.

II.1Primary recovery mechanisms of gas reservoirs

The determination of the drive mechanism is crucial in the early life of the reservoir, as its recognition can significantly improve the management and recovery of reserves from the reservoir in its middle and later life and can help reach a proper understanding of reservoir behaviour. For gas reservoirs, three drive mechanisms are associated with conventional ones and a fourth is associated with unconventional ones. These are:

- **II.1.1 Gas Expansion** is the primary drive mechanism in most conventional gas reservoirs. This mechanism is very efficient and commonly results in recoveries as high as 85 percent of the original gas in place. In this type of reservoir, the principal source of energy is a result of the subsequent expansion of the solution gas as the reservoir pressure is reduced.
- **II.1.2 Rock and Fluid Expansion** in gas reservoirs is identical to that in oil reservoirs. It occurs due to the slightly compressible nature of the Connate Water and the reservoir rock. This expansion adds energy to the reservoir and acts to keep the reservoir pressure higher than it would be otherwise. This expansion mechanism is always dominated by gas expansion and may only be significant in cases of over-pressured reservoirs.
- **II.1.3** Aquifer Drive (water encroachment) The final drive mechanism is associated with conventional gas reservoirs. Like oil reservoirs, this drive mechanism occurs when the reservoir communicates with a water-bearing aquifer. As the reservoir pressure declines, the rock and water in the aquifer expand, and water is expelled from the aquifer and into the reservoir. This invasion of water into the reservoir provides pressure support.
- **II.1.4 Gas Desorption** A drive mechanism that is associated with certain unconventional gas reservoirs is. shale gas reservoirs and coal seam methane reservoirs have a high content of organic material in the reservoir rock. This organic-rich rock material has the ability to Absorb gas onto its surface (gas stored by adhesion onto the surface). As pressure is depleted, this adsorbed gas is released to the pore volume of the reservoir by the Desorption Process. This desorption of gas may dominate production from the unconventional gas reservoirs in which it occurs. **[8]**

II.2 Reservoir Pressure Depletion

During the life of a producing hydrocarbon field, several production stages are encountered. Initially, when a field is brought into production, hydrocarbons flow naturally to the surface due to current reservoir pressure in the primary stage. The primary production rate will decline over time due to reservoir pressure depletion associated with fluid production. The drop is rapid, continuous, and usually very gradual. This behaviour is attributed to the fact that no extraneous fluids or gas caps are available to replenish the extracted gas and oil.

II.3 Prediction of Reservoir Performance

Prediction of reservoir performance is a vital aspect of the oil and gas industry which guides management's decision of how the reservoir will behave in the future. This implies that its success will depend solely on the accurate description of the reservoir rock properties, fluid properties, rock-fluid properties and flow performance. Reservoir characterization is an ongoing process throughout the field's lifespan, aimed at reducing or identifying uncertainties associated with the static and dynamic reservoir model.

Volumetric, material balance and Decline Curve Analysis (DCA) are the three main techniques used to provide insight into estimating the amount of oil and gas initially in place (OOIP/GIIP) within a reservoir and predict future production.

TABLE II.1: Comparison between the 3 main meth	ods used to Predict reservoir performance
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Method	Description	Data Requirements	Advantages	Limitations
Volumetric	Estimates OOIP/GIIP using the geometry, porosity, and saturation of the reservoir.	Reservoir dimensions, porosity, saturation	Simple, minimal data required	Accuracy depends on data quality, ignores complexities
Material Balance (MBAL)	Applies law of conservation of mass to track hydrocarbons.	Production history, pressure data, FVF, GOR	Considers production history & pressure changes	Requires more data, pressure data crucial, may not be reliable early on
Decline Curve Analysis (DCA)	Analyzes historical production data to forecast future rates.	Historical production data (oil/gas rates vs. time)	Relatively simple, quick estimates & forecasting	Depends on data quality & length, doesn't account for reservoir properties, future behavior may deviate

In practice, a combination of these methods is often used to get a more robust estimation of reserves. The choice of method depends on the available data and the specific characteristics of the reservoir.

In this study, the prediction methods used incorporated the material balance equation (MBE) which is predominantly pressure-temperature-volume (PVT) properties.

II.4 Material Balance Equation (MBE)

The material balance equation (MBE) is the classical mathematical representation of the reservoir. The concept of the MBE was presented by Schilthuis in 1936 and is based on the principle of the volumetric balance. **[9]**

The material balance equation (MBE) has long been recognized as one of the basic tools for interpreting and predicting reservoir performance. The MBE can be used to:

- Estimate initial hydrocarbon volumes in place.
- Predict reservoir pressure.
- Calculate water influx.
- Predict future reservoir performance.
- Predict ultimate hydrocarbon recovery under various types of primary drive mechanisms.

The accuracy of the calculated values depends on the reliability of the available data, and whether the reservoir characteristics meet the assumptions that are associated with the development of the MBE. The equation is structured to keep an inventory of all materials entering, leaving, and accumulating in the reservoir.

II.4.1 Basic Assumptions in the MBE

The MBE equation is based on premises used to simplify and eliminate the elements hindering the calculation process while maintaining result accuracy. The basic assumptions in the MBE are:

- a) **Constant Temperature:** Pressure-volume changes in the reservoir are assumed to occur without any temperature changes. If any temperature changes occur, they are usually sufficiently small to be ignored without significant error.
- b) Reservoir Characteristics: The reservoir has uniform porosity, permeability, and thickness characteristics. In addition, the shifting in the gas-oil contact or oil-water contact is uniform throughout the reservoir.
- c) Fluid Recovery: The fluid recovery is considered independent of the rate, number of wells, or location of the wells. The time element is not explicitly expressed in the material balance when applied to predict future reservoir performance.

- d) Pressure Equilibrium: All parts of the reservoir have the same pressure, and fluid properties are therefore constant throughout.
- e) Constant Reservoir Volume: Reservoir volume is assumed to be constant except for those conditions of rock and water expansion or water influx that are specifically considered in the equation.
- f) It is assumed that the PVT samples or datasets represent the actual fluid compositions and that reliable and representative laboratory procedures have been used. [9]

II.4.2 Development of the General Material Balance Equation

The law of conservation of mass is the basis of material balance calculations. Material balance is an accounting of material entering or leaving a system. In its simplest form, the equation can be written on a volumetric basis as:

Initial volume = Volume remaining + Volume removed

The MBE is designed to treat the reservoir as a *single tank* or a region that is characterized by homogeneous rock properties and described by an average pressure, i.e., no pressure variation throughout the reservoir at any particular time or stage of production. Therefore, the MBE is commonly referred to as a tank model or a zero-dimensional (0-D) model. These assumptions are of course unrealistic since reservoirs are generally considered heterogeneous with considerable variation in pressures throughout the reservoir.

However, it is shown that the tank-type model accurately predicts the behaviour of the reservoir in most cases if accurate average pressures and production data are available.

II.4.3 Gas Reservoir Material Balance

The initial gas in place G, the initial reservoir pressure pi, and the gas reserves are possible to calculate if enough production-pressure history is available for a gas reservoir. This is accomplished by forming a mass or mole balance on the gas as:

$$\mathbf{n}_{\mathbf{p}} = \mathbf{n}_{\mathbf{i}} - \mathbf{n}_{\mathbf{f}} \tag{II.1}$$

Figure II-1 represents a gas reservoir as an idealized gas container, the equation II.1 gas moles can be replaced by their equivalents using the real gas law to give:

$$\frac{P_{sc}G_p}{RT_{sc}} = \frac{VP_i}{z_iRT} - \frac{P[V-(W_e-W_p)]}{zRT}$$
(II.2)



Figure II-1 An idealized water-drive gas reservoir. [4]

Essentially equation II.2 is the general material balance equation (MBE). There are several ways to express equation II.2 depending on the application type and the driving mechanism. In general, there are two types of dry gas reservoirs:

- Volumetric gas reservoirs
- Water-drive gas reservoirs

For a volumetric reservoir and assuming no water production, equation II.2 becomes:

$$\frac{P_{sc}G_{p}}{T_{sc}} = \left(\frac{P_{i}}{z_{i}T}\right)V - \left(\frac{P}{zT}\right)V$$
(II.3)

Rearranging equation II.3 and solving for p/z gives:

$$\frac{P}{z} = \frac{P_i}{z_i} - \left(\frac{P_{sc}T}{T_{sc}V}\right)G_p$$
(II.4)

As illustrated in Figure II-2, equation II.4 generates a straight line when (p/z) is plotted versus the cumulative gas production Gp. This straight-line relationship is perhaps one of the most widely used relationships in gas reserve determination.



Figure II-2 Gas material balance equation "Tank Model." [4]

II.5 Nodal analysis

Nodal analysis is a technique used to analyze the flow behaviour and pressure distribution throughout a production by dividing the system into segments or nodes allows for the analysis of this system and ensures transportation of oil and gas from the reservoir to the surface takes place through a system of pipes, including the porous medium, tubing, and the surface gathering network with minimal losses. It is relatively straightforward to calculate the pressure drop for each of these segments if we know the flow rate either the upstream or downstream pressure, and the physical properties of the segment. This allows us to:

- Identify bottlenecks.
- Predict flow rates.
- Optimize production strategies.
- Improve artificial lift.
- Ensure flow assurance.

When we graph these two curves on the same graph, we refer to this as the "system graph". The intersection of the inflow curve and the outflow curve gives the one unique flow rate at which the well will produce a specified set of reservoir and wellbore properties. The point of intersection will also give the unique bottom-hole pressure at which this rate will occur:



Figure II.3: Different Pressure Loses in the production system (Reservoir to separator).

Types of Pressure Losses in the production system:

- Reservoir Skin: $(\Delta P_1 = p_R p_{wfs})$
- Wellbore Friction: ($\Delta P_2 = p_{wfs} p_{wf}$).
- Tubing and Flowline Friction: $(\Delta P_3 = p_{ur} p_{dr})$.
- Safety Valve Pressure Drop: $(\Delta P_4 = P_{usv} P_{dsv})$.
- Choke Pressure Drop: $(\Delta P_5 = P_{wh} P_{dsc})$.
- Surface Line Friction: $(\Delta P_6 = P_{dsc} P_{Sep})$.
- Total Pressure Loss in Tubing: $(\Delta P_7 = Pwf Pwh)$.
- Separator Pressure Drop: $(\Delta P_8 = P_{WH} P_{sep})$.

The system is divided into two parts based on the nodal point:

II.5.1 Inflow Performance Relationship (IPR)

The inflow curve describes the relationship between the bottomhole pressure and the flow rate for the reservoir.

- Reservoir pressure
- Reservoir quality (permeability and thickness).
- Completion efficiency (or skin).

- Relative permeability (change in permeability as water production starts).

II.5.2 Tubing Performance Curves (TPC)

The outflow curve describes the relationship between the pressure (Pwf) at the solution node and the flow rate (Qs) out of the node the flowing bottom-hole pressure and the flowrate for the wellbore, and acceleration within the tubing, pipes, and lines.

TPC: $\mathbf{Pwf} = \mathbf{Pwh} - \Delta \mathbf{P} \text{ tubing} - \Delta \mathbf{P} \text{ annulus} - \Delta \mathbf{P} \text{ restrictions}$ (II.5)

If we had chosen a different point as our solution node, the shapes of the curves would have been different. The intersection of the inflow and outflow curves would have given the pressure at the new solution node. The flow rate at which the curves intersect, however, will be the same no matter where the solution node is taken. Calculated intersection points may differ slightly because of numerical errors.

II.5.3 The Intersection: The Operating Point

The operating point is the intersection of the IPR and TPC curves. This point represents the production rate and flowing bottomhole pressure at which the well is currently operating.

The system for transporting the fluid can be divided into three parts:

- Flow in the porous medium;
- Flow in vertical or directional pipes;
- Flow in horizontal pipelines.



Figure II.4: The operating point.

The choice and sizing of the different components is very important, but due to the interaction between the components, a change in one of them can change the behavior of the fluid in the others. This is why the production system (reservoir + well + surface collection) must be analyzed as a single unit. Analyzing each part separately does not lead to good results.

The production of a well can often be limited by the performance of a single component of the system. If the effect of each component on the system performance can be isolated, then the system performance can be optimized in the most economical way.

II.6 Back pressure equation

The back pressure equation is referred to as the oil and gas deliverability equation method that can be used to specify the Inflow Performance Relationship (IPR) for completion. This equation is also a fundamental concept in fluid mechanics used to estimate the pressure remaining at a specific point in a pipeline system. It's particularly relevant in the context of gas well boosting, where we want to ensure sufficient pressure at the end of the pipeline (treatment facility) after transporting gas from the wellhead. This equation is represented in the following form:

$$Q = C(p_{ws}^2 - p_{wf}^2)^n$$
(II.6)
Where:

$$C = \frac{703 \times 10 - 6 \text{ kh}}{\mu \text{TZ} \left[ln \left(\frac{r_e}{r_w} \right) - \frac{4}{3} + s \right]}$$
(II.7)

NB:

- The exponent "n" value ranges between 0.5 (for completely turbulent flow) to 1.0 (for pure laminar flow).
- The coefficient "C" represents the Productivity Index of the reservoir. 1.0 is often due to non-darcy flow effects.

Typically, backpressure tests consist of a series of at least three stabilized flow rates and the measurement of bottomhole flowing pressures as a function of time during these flow intervals.

The simplified back pressure equation is helpful for initial estimations, but it doesn't account for all factors influencing pressure drop. For more accurate calculations, it needs to consider the detailed flow rate calculation and pressure drop formulas with relevant fluid properties.



Figure II.5: Conventional Back-Pressure Test.



Chapter III

Boosting Method and the Candidate Wells



III. Introduction

In this chapter, we will list the wells that have been suggested for potential boosting and outline the specific criteria that need to be met for their selection. Additionally, we will provide a detailed overview of the chosen booster, including its equipment and key characteristics.

III.1 Selection of candidate wells

With the aim to determine the possibility of installing a Booster appropriate for wells with low potential in the Brides field. It is essential to study the compatibility of the compression unit with the wells' characteristics, location, and operating environment as well as any potential operational restrictions. The requirement to recover the total investment cost lost must also be taken into account.

The low potential wells in the Brides field are BDSN-1, BDSN-2, BRD1, BRD12, BRD15, BRDS-1, BRDS-2 and BRDS-EXT02. which are connected to a high-pressure manifold BRDMF01, and they are currently unable to produce at the existing manifold pressure of 80 bar due to their pressure decline as shown in figure III.1. To address this issue, installing a booster to elevate their pressure has been proposed, allowing them to continue production at the same manifold pressure.



Figure III-1 Connection of manifolds and wells placement. [10]

As it is evident in the diagram above, the well BRD-1 is connected to a junction with BRD-14, which operates at a higher pressure than BRD-1 and has the capability to produce at the existing manifold pressure. Therefore, we will exclude it from the wells programmed to be boosted.

III.1.1 History of candidate wells

The Brides field was put into operation on 04/12/2013 with the opening of 03 wells (BRD12-13-15). Later, the wells BRDS-1, BRDS-2, BRDS-Ext2, BDSN-1 and BDSN-2 began production in January 2022.

Wells	Observations	Start of production date
RDD 15	04/06/2012 TO 20/06/2012 Well	04/12/2012
BKD-15	completion in main TAGS reservoir	04/12/2015
	04/06/2012 TO 18/06/2012 Well	04/12/2012
DKD-12	completion in main TAGS reservoir	04/12/2013
DDCN 1	Drilling: from 11/01/2014 to 25/05/2014	01/02/2022
BD2N-1	Completion: 25/06/2014	01/02/2022
RDSN_2	Drilling: from 21/03/2016 to 26/07/2016	01/01/2022
DDSIN-2	Completion: 26/07/2016	01/01/2022
	Start of drilling: 01/05/2009, End of	
	drilling: 14/04/2010, TD depth sounder:	
DDDC 1	5534m	01/01/2022
DKD5-1	Work Over "ENF 34" (From 02/07 to	
	03/22/2018): Completion of the well in the	
	Silurian B2 reservoir.	
	Start of Drilling: 11/04/2015, End of	
RDDS 2	Drilling: 17/10/2015	01/02/2022
DKD5-2	Start of completion 17/10/2015, End of	
	completion 31/10/2015	
	Start of drilling: 12/11/2015; end of	01/03/2022
BRDS-Ext2	drilling: 04/10/2016 Start of completion:	01/03/2022
	12/25/2018; end of completion: 02/14/2019	

Table III.1: history of candidate wells. [10] [11]

III.1.2 DATA of candidate wells

The table below presents a collection of well test data for candidate wells acquired from gauging tests:

Wellbore	Date	Choke (-/64)	Q Gas (Sm3/J)	Q Cond (m3/J)	Q Water (m3/J)	Whp (Barg)	WHT (°C)	Bhfp (psig)	BWFT (°C)	Depth (m)
BDSN-1	23/07/2023	24	73 560	52,7	0	112,32	48	2644,70	105,82	2925
BDSN-1	24/07/2023	32	93 264	61,97	1,63	76,26	45	1948,75	103,55	2925
BDSN-1	25/07/2023	40	102 144	65,3	1,97	55,92	48	1527,04	101,21	2925
BDSN-1	19/10/2023	-	64 632	29,74	3,98	230,01	36	-	-	-
BDSN-2	20/06/2023	24	40 320	32,54	0	55,99	43	1817,33	107,19	2923
BDSN-2	21/06/2023	32	45 240	17,18	7,49	37,23	44	1281,62	106,23	2923
BDSN-2	22/06/2023	40	54 816	21,7	6,22	27,37	38	959,53	104,75	2923
BDSN-2	20/10/2023	-	62 376	19,27	0	59 <i>,</i> 98	38	-	-	-
BRD-12	15/02/2018	55	373 296	72,94	0	172,37	70	-	-	-
BRD-12	22/12/2018	24	174 853	39,02	0,53	170,30	54	-	-	-
BRD-12	10/07/2023	24	11 232	0	0	44,61	46	-	-	-
BRD-15	16/02/2018	12	260 080	57,41	0	149,96	67	-	-	-
BRD-15	08/07/2023	12	64 664	0	0	48,75	53	-	-	-
BRD-15	09/07/2023	42	62 160	0	0	44,54	60	-	-	-
BRDS-1	02/07/2023	24	107 400	59,06	2,21	156,03	53	3420,86	123,73	3891
BRDS-1	03/07/2023	32	158 280	63,43	5,47	122,11	55	2582,93	121,57	3891
BRDS-1	04/07/2023	40	187 488	62,16	4,03	96,18	60	2031,64	119,06	3891
BRDS-1	13/10/2023	-	97 920	0,82	0	121,97	37	-	-	-
BRDS-1	14/10/2023	-	120 072	0,79	0	215,12	37	-	-	-
BRDS-1	15/10/2023	-	127 344	0	0	188,64	35	-	-	-
BRDS-2	25/06/2023	24	34 752	26,04	0	58,19	49	1637,16	111,01	3585
BRDS-2	26/06/2023	32	37 632	26,04	26,04	31,72	50	1119,15	105,51	3585
BRDS-2	27/06/2023	40	40 248	27,29	0	22,27	46	891,25	102,77	3585
BRDS-2	16/10/2023	-	66 984	0	0	56,99	38	-	-	-
BRDS- Ext2	16/01/2020	24	131 249	117,42	0,79	149,42	39	3700,64	132,50	4407
BRDS- Ext2	17/01/2020	32	150 748	125,39	2,04	104,61	43	2612,12	127,80	4407
BRDS- Ext2	18/01/2020	36	150 953	111,54	2,45	83,99	46	2156,24	124,80	4407
BRDS- Ext2	17/10/2023	-	51 192	0	0	43,99	39	-	-	-
BRDS- Ext2	18/10/2023	-	22 200	0	0	73,98	41	-	-	-

Table II	I.2: well	test	data	for	candidate	wells.	[12]
Lable II		icsi	uata	101	canalaate	W 0115.	L∓#J

III.2 The operating procedures for Boosting unit

III.2.1 Pressure Boosting:

In oil and gas production, multiphase pressure boosting acts like a heartbeat, ensuring efficient transport of well fluids (oil, gas, and water mix) from the reservoir to processing facilities. This boosting system is crucial for maximizing production. It can be a cost-effective alternative to well intervention and helps recover more hydrocarbons by overcoming pressure drops in pipelines, ultimately extending the life of the oilfield. However, for stable operation, the system requires careful consideration beyond just the booster itself. Monitoring the reservoir, designing pipelines for the specific flow conditions, and selecting the right boosting technology are all essential for ensuring smooth flow and maximizing production efficiency.

The main goal is to maintain a steady flow of oil and gas. As production circumstances change, well fluids need to travel long distances to reach processing facilities. Here, boosting wellhead pressure becomes essential to overcome the backpressure created by the downstream gas flow system.

III.2.2 Natural Reservoir Pressure Depletion

In some cases, natural reservoir pressure might be insufficient for production, particularly for:

- Gas-condensate fields (reservoirs with a mix of natural gas and light liquid hydrocarbons)
- Natural gas extracted from underground reservoirs often has insufficient pressure to travel long distances through pipelines.

III.2.3 Requirement for Boosting:

There are three main categories of transport limitations:

- A Natural depletion is insufficient: The natural pressure in the reservoir is not strong enough to push the oil to the surface efficiently.
- **Reservoir pressure needs maintenance:** The reservoir pressure needs to be maintained to achieve a desired production rate.

Transport of well fluids needs Boosting: The distance to processing facilities or other factors hinder the natural flow of oil and require additional assistance.

III.2.4 Factors Affecting Lift Method Selection

The choice of an artificial lift method depends on several factors:

a) Reservoir conditions :

- Initial reservoir pressure.
- Driving mechanisms (e.g., gas cap, water drive).
- Properties of the fluids (oil viscosity, gas-to-oil ratio).

b) "Geographical" conditions :

- Distance to processing facilities.
- Water depth (offshore).
- Seabed topography (offshore). [13] [14]

III.3 Boosting equipment

The gas engine compressors do not require any electrical source hence they can be installed quickly and the running cost is low.

On-demand compression unit includes:

- Separating the Condensate / Gas phases
- Boosting the gas production for export and overcoming the downstream back pressure.
- Transfer the recovered condensate to an export line (same as a gas export line or separate line). [15]

There are various types of Boosters used for gas wells, including:

• **Reciprocating compressors:** Use pistons to compress the gas in stages. These compressors use rotating impellers to accelerate the gas, converting kinetic energy into pressure gain.

- **Centrifugal compressors:** Use rotating impellers to increase gas pressure. They employ centrifugal force generated by high speed.
- Screw compressors: Utilize intermeshing screws to trap and compress the gas as they rotate. They offer continuous flow and are well-suited for high-pressure applications. [16]

Here are some additional components that are often used in conjunction with gas-boosting equipment:

- **Inlet separators:** These remove liquids and impurities from the gas stream before they enter the compressor to protect the equipment.
- Scrubber: A scrubber is typically a device used to remove unwanted components from a gas stream. This could involve removing liquids, solids, or specific gas components depending on the application.
- Aftercoolers: These cool down the gas after compression as the compression process generates heat. Cooling the gas reduces its volume and improves its efficiency in the pipeline.
- **Discharge separators:** These remove any liquids or condensates that may form after cooling the gas.
- **Control valves:** These regulate the flow of gas through the system and maintain the desired pressure.
- **Piping and valves:** These connect the various components of the gas boosting system and allow for controlled flow of the gas. **[17]**



Figure III.2: Compressor unit components. [15]

III.4 Specific Features of the Chosen Booster

As previously mentioned, the wells are linked to the high-pressure manifold (HP MF). When the pressure in the reservoir drops, the boosting method is essential to sustain the production of the wells at a high pressure to uphold the pressure of the wellhead and the flowline, an artificial method becomes necessary. by elevating the pressure of fluid to align with the original pressure of the manifold, which stands at approximately 90 Bar, whereas the pressure reaching the manifold is only 40 Bar.

The following are the features of the Booster, which have been selected based on the available data and features:

Capacity	Suction Pressure	Discharge Pressure	Fuel gas consumption	Compressor Frame
600,000 to 900,000	40 to 60	105	8000	1117 Kw
Sm ³ /day	Barg	Barg	Sm ³ /day	1117 KW

Table III.3: Specific features of the chosen Boosting unit.

NB: To ensure the efficiency of the compression unit, an optimum flow rate of 300,000 Sm3/d is necessary during the production.

Chapter III



PUMPS

Figure III.3: Main equipment of the Boosting unit. [15]

III.5 Boosting unit operation

The role of the Boosting unit is to increase the pressure of the fluids from the candidate wells so that they can reach the processing centre. This is achieved by separating the liquid phase from the gaseous phase using an on-site 3-phase separator. The gaseous phase then goes through a compressor, while the liquid phase passes through a pump, elevating the fluids' pressure to 90 bars. After this, the two phases are combined at a junction point. The fluid, now at a higher pressure, is then injected into the manifold and sent to the CPF (centre processing facility).



NB: BRDMF-01BIS is a manifold that contains three wells which are: BRDS-1, BRDS-2 and BRDS-Ext2.

Figure III.4: diagram of the Boosting process.

III.6 Factors affecting Booster selection

Key factors influencing the booster selection are:

- Wellhead pressure.
- The pressure required for the gas to reach its destination.
- The flow rate of gas that needs to be transported per unit time.
- Cost of installation, operation, and maintenance. [13] [14]

III.7 Various applications of Boosting

Gas boosting has various applications across different industries. Here's some key areas where gas boosting plays a vital role:

- Boosting stations are positioned at strategic points along gas gathering and to maintain sufficient pressure for continued flow.
- Boosters are essentially compressors that take in low-pressure gas from the gas well and compress it to a higher pressure. [15]

III.8 The advantages of Boosting technology

Gas well boosting plays a critical role in maximizing natural gas production, enabling efficient transportation over long distances, and facilitating the development of previously inaccessible gas reserves. Here are some advantages of this technology:

- Sustain and enhance gas recovery.
- Reduce backpressure on wells.
- Keep/back to the required inlet pressure of the main facility (sustain inlet design pressure).
- Self-powered and fully automated
- Temporary replacement compressor for units that are under maintenance.
- Enables Long-Distance Transportation
- Environnemental Benefits.



Chapter IV

Modeling and Forecasting of the Impact

of the Booster on Candidate

Wells



IV. Introduction

In this chapter, we will delve into the result of our research, providing a detailed analysis of the use of MBAL software and PIPESIM software to model and forecast the potential impacts of implementing a Boosting unit on the candidate wells. Furthermore, we will assess the financial ramifications of implementing a Boosting unit.

IV.1 Using MBAL Software

IV.1.1 Introduction to the MBAL Software

Accurate production prediction is paramount for optimizing field development and maximizing recoverable resources. MBAL (Material Balance) software - commercialised in the early 1990s- developed by Petroleum Experts as a component of their Integrated Production Modeling (IPM) suite, stands as a prominent tool for achieving this objective. **[18]**

Aside from *Material Balance*, other tools also available are:

- Decline Curve Analysis.
- 1D model.
- Monte Carlo Simulations.
- Coal Bed Methane.
- Reservoir Allocation.
- Tight Reservoir Modelling.
- Streamlines.

All available techniques can be used in isolation or in combination to achieve various objectives. [18]

Notably, MBAL offers three primary deployment strategies for reservoir production prediction:

- a) Integration Within a Comprehensive Reservoir Model: MBAL seamlessly integrates with various other IPM tools to establish a robust reservoir model. This model incorporates a wide array of data, including:
 - **Production History:** tracking of Oil, gas, and water production volumes over time.
 - PVT Analysis: detailed characterization of reservoir fluid properties at different pressures and temperatures.

- Rock Properties: comprehensive analysis of the reservoir's rock formations, including porosity, permeability, and other critical characteristics.
- b) Standalone Reservoir Analysis Tool: MBAL exhibits its versatility by functioning independently for basic reservoir analysis. it leverages historical production data and PVT analysis results to generate production forecasts.
- c) Applications in Reservoir Production Prediction: MBAL provides comprehensive tools to predict reservoir production accurately:
 - **History Matching:** The history matching is carried out utilizing the graphical and analytical approaches. It involves adjusting model parameters to align with past production data closely. MBAL facilitates this process, ensuring the model accurately reflects the reservoir's historical behaviour. **[19] [20]**
 - **Bottomhole Pressure Analysis:** The MBAL algorithm evaluates reservoir bottomhole pressure using measured pressure and production data, utilizing material balance equations to estimate background pressure.
 - **Reservoir Property Estimation:** Using production data and material balance calculations, MBAL can estimate Original Oil in Place (OOIP), Original Gas in Place (OGIP), and aquifer properties.
 - **Production Forecasting:** MBAL excels at forecasting future production under various scenarios after estimating reservoir properties and completing history matching. This helps to optimize production strategies.

IV.1.2 MBAL Models Inputs

Input Parameters		Correlations
Separator pressure 43,7817	BARa	Gas viscosity
Separator temperature 78,26	deg F	Lee et al
Separator GOR 3580,3	m3/m3	
Separator gas gravity 0,666	sp. gravity	
Tank GOR 79	m3/m3	
Tank gas gravity 1,178	sp. gravity	
Condensate gravity 61,81	API	
Water salinity 300000	ppm	
Dewpoint at reservoir 370,366	BARa	
Reservoir temperature 233,6	deg F	
Reservoir pressure 172,279	BARa	
Mole Percent H2S 0		Illse Tables
Mole Percent CO2 0,918		Use Matching
Mole Percent N2 0,511		Model <u>W</u> ater Vapour

a) **PVT Description:**

Figure IV.1: PVT inputs of Main TAGS reservoir.

Input Parameters		Correlations
Separator pressure 86,4313	BARa	Gas viscosity
Separator temperature 40	deg C	Lee et al
Separator GOR 3114,68	Sm3/Sm3	
Separator gas gravity 0,668	sp. gravity	
Tank GOR 0	Sm3/Sm3	
Tank gas gravity 0,7728	sp. gravity	
Condensate gravity 55,99	API	
Water salinity 300000	ppm	
Dewpoint at reservoir 386,43	BARa	
Reservoir temperature 117	deg C	
Reservoir pressure 228,474	BARa	
Mole Percent H2S		V Lise Tables
Mole Percent CO2 1,06		Use Matching
Mole Percent N2 0,62		Model <u>W</u> ater Vapour

Figure IV.2: PVT inputs of West TAGS reservoir.

Input Parameters			Correlations
Separator pressure	10	BARa	Gas viscosity
Separator temperature	53,6	deg F	Lee et al
Separator GOR	1677,55	Sm3/Sm3	
Separator gas gravity	0,65	sp. gravity	
Tank GOR	112	Sm3/Sm3	
Tank gas gravity	1,377	sp. gravity	
Condensate gravity	57,82	API	
Water salinity	300000	ppm	
Dewpoint at reservoir	370,366	BARa	
Reservoir temperature	221	deg F	
Reservoir pressure	314,656	BARa	
Mole Percent H2S	0		V Lice Tables
Mole Percent CO2	0,995		Use Matching
Mole Percent N2	1,044		Model <u>W</u> ater Vapour

Figure IV.3: PVT inputs of North TAGS reservoir.

b) Reservoir Description

Tank Parameters	Water Influx	Rock Compress.	Rock Compaction	Pore Volume vs Depth	Relative Permeabi	e Well Production Allocation	Production History	
	T	ank Type F	Retrograde Cor	idensate 💌	[Monitor Co	ontacts	
		Name M	lain TAGS			🔄 Use Fractio	onal Flow Tab	le (instead of rel perms)
	Ter	mperature 2	33,6	deg F				
	Initia	Pressure 3	82,607	BARa				
		Porosity 0	,14	fraction				
Co	nnate Water S	Saturation 0	,27	fraction				
	Water Com	oressibility U	lse Corr	1/psi				
	Original Ga	s In Place 8	,77471e+9	Sm3				
	Start of P	roduction 2	6/05/2012	date d/m/y				
<< Prior	Next >>	Valida	ite					

Figure IV.4: Tank inputs of Main TAGS reservoir.

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Tank Parameters	Water Influx	Rock Compress.	Rock Compaction	Pore Volume vs Depth	Relativ Permeab	e Well Production Allocation	Production History	
	Т	ank Type	Retrograde Cor	ndensate 💌	[Monitor Co	ontacts	
		Name [TAGS WEST			🔄 Use Fracti	onal Flow Tab	le (instead of rel perms)
	Ter	mperature	114,5	deg C				
	Initia	Pressure	403,338	BARa				
		Porosity 0	0,1	fraction				
Co	nnate Water 9	Saturation	0,29	fraction				
	Water Comp	oressibility 🛛	Use Corr	1/psi				
	Original Ga	s In Place 🛛	5,00964e+9	Sm3				
	Start of P	roduction	01/12/2013	date d/m/y				
<< Prior	Next >>	Valid	ate					

Figure IV.5: Tank inputs of West TAGS reservoir.

Tank Parameters	Water Influx	Rock Compress	Rock Compaction	Pore Volume vs Depth	Relative Permeabi	e Well Production Allocation	Production History		
	Т	ank Type	Retrograde Cor	ndensate 💌	[Monitor Co	ontacts		
		Name	TAGS North			🔄 Use Fractio	onal Flow Tab	le (instead of rel perms)	
	Te	mperature	221	deg F					
	Initia	I Pressure	419,513	BARa					
		Porosity	0,13	fraction					
C0	nnate Water !	Saturation	0,49	fraction					
	Water Com	pressibility	Use Corr	1/psi					
	Original Ga	s In Place	4,74638e+8	Sm3					
	Start of F	Production	26/05/2014	date d/m/y					
<< Prior	Next >>	Valio	late						

Figure IV.6: Tank inputs of North TAGS reservoir.

IV.1.3 History Matching for the MBAL Models



a. Analytical Method





Figure IV.8: Analytical plot of West TAGS reservoir after regression.



Figure IV.9: Analytical plot of North TAGS reservoir after regression.



b. Graphical Method

Figure IV.10: Graphical plot of Main TAGS reservoir after regression.



Figure IV.11: Graphical plot of West TAGS reservoir after regression.



Figure IV.12: Graphical plot of North TAGS reservoir after regression.

IV.1.4 Reservoirs Pressure and Production Predictions

The graphical representation of historical production data is utilized to construct a model that accurately reflects the behavior of the reservoirs, enabling the performance of predictive analysis on the reservoirs.



a. Reservoirs Pressure





Figure IV.14: Production prediction of tank pressure from the end of history data to the year 2045 West TAGS.

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Figure IV.15: Production prediction of tank pressure from the end of history data to the year 2040 North TAGS.



Figure IV.16: Production prediction of cumulative gas and condensate production from the end of history data to the year 2042 Main TAGS.

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Figure IV.17: Production prediction of cumulative gas and condensate production from the end of history data to the year 2045 West TAGS.



Figure IV.18: Production prediction of cumulative gas and condensate production from the end of history data to the year 2040 North TAGS.

IV.1.5 Results and commentary

We were able to determine the following values of initial gas volume within our reservoir by utilizing the Mbal software:

reservoir	Original gas in place (MMsm3)
Main TAGS	8,77
West TAGS	5
North TAGS	0,47

Table IV.1: Original gas in place using Mbal software.

The reservoir pressure prediction of Mbal software enables us to determine the approximate future date that our reservoirs can no longer produce under the current production conditions. Implementation of a booster system holds the potential to extend the productive lifespan of these reservoirs by adapting them to operate under new conditions.

If we took these facts into consideration, we could calculate approximately the cumulative hydrocarbon expected to be produced during the time we gained by using a booster:

reservoir	expected gained time	cumulative gas Produced	cumulative condensate Produced
	year	Msm3	Msm3
Main TAGS	5	864,50	0,13
West TAGS	2	400,40	0,06
North TAGS	4	80,40	0,03

Table IV.2: cumulative hydrocarbon expected to be produced by using a Booster.

IV.2 Using PIPESIM Software

IV.2.1 Introduction to the PIPESIM Software

PIPESIM is a valuable steady-state multiphase flow simulator software developed by Schlumberger for oil and gas engineers involved in pipeline design, flow assurance analysis, and production system optimization, that empowers to optimize well performance and ensure the efficient operation of complex production systems and reservoir engineers to accurately predict flow and temperature behavior within wellbores and pipelines. Its robust capabilities enable users to:

- Well Performance Analysis: It facilitates the creation of accurate and representative well models.
- **Network Analysis:** Pipesim enables the simulation of an entire well network's behaviour by analyzing the impact of various network parameters.
- **Optimize existing designs:** By simulating various scenarios and tweaking parameters like choke settings, tubing sizes, and artificial lift methods, PIPESIM helps identify bottlenecks and uncover hidden potential for production improvement.
- **Predict the effects of future changes:** The ever-changing nature of oil and gas production demands proactive planning, enabling proactive decision-making.
- Model and simulate production systems: Once calibrated with real-world field data, it can be used to model and simulate the behavior of complex production systems.
- **Study system sensitivity:** PIPESIM facilitates comprehensive sensitivity analysis, and identifies critical factors.
- Gap Between Theory and Reality: It allows to calibrate their models with real-world field data. Once calibrated, predict their behavior under various conditions, and identify areas for optimization. [21] [22]

Here's an overview of Pipesim's key functionalities:

- Multiphase Flow Modeling.
- Steady-State Analysis.
- Pipeline Modeling.
- Wellbore Modeling.
- Facility Modeling.
- Production System Analysis.
- Artificial Lift Design. [21]

IV.2.2 Modeling of the Candidate wells

This is crucial for accurately simulating production systems of multiphase flow, considering the behaviour of oil, gas, and water mixtures within the network. So, we can see the matching of the candidates wells (BDSN-1, BDSN-2, BRDS-1, BRDS-2, BRD-12, BRD-15, BRDS-

Ext2) to the manifold BRDMF01, the booster that is located there verses GEA-MF to NZ-MF directly to the processing facility (Cpf), as is showed in the figure



Figure IV.19: Network schematic of Boosting Model.



Figure IV.20: GIS of Boosting Model.

To enhance the accuracy and approximation of well-design simulations in PIPESIM, we employ well-technical sheets as a reference guide. These technical sheets provide comprehensive information about the well's characteristics, including its geometry, formation properties, fluid properties, and production data. By incorporating this information into PIPESIM, we can refine the well design model and achieve a more realistic representation of the well.



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Figure IV.21: PIPESIM models of candidate wells.

IV.2.3 Wellhead Pressure simulation

Generating reservoir performance curves (IPR) for individual wells using well-test data and the PIPESIM software is crucial for optimizing well production and reservoir management strategies.

PIPESIM utilizes the multi-rate method, a common technique for generating IPR curves, the core of this method lies in determining the coefficients "c" and "n".



Figure IV.22: Curve IPR of BDSN-01

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	Name	Geometry pro	Fluid entry	Top MD	Middle MD	Bottom MD	Туре	Active	IPR model
-				ft -	ft •	ft •			
1	BDSN-2	Vertical 🔹	Single point 🔹	///////////////////////////////////////	12294,95	[]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]	Perforation	√	Back press *
+									
Rese	rvoir Sand Fl	uid model							
Res	ervoir pressure:	4336,085	psig	•			1	1	
Res	ervoir temperatur	e: 105	degC	•	4000-	<u> </u>			
IPR	basis:	Gas							
Con	stant C:	0,002605886	sm3/d/psi^2n	•	3500-				
Slop	be n:	1			3000-				
Use	test data:	1			a 2500				
Test	type:	O Multipoint	Isochronal		isd				
	Q	Pwf	Pws		2000- 2000-				
	sm3/d	psig	• psig	•	1500-				
1	40320	1817,328	4336,085	A	1000				
2	45240	1281,617	4336,085	_	1000				
3	_			_	500-				
4				-	0-				\
+				-	0	10000	20000 30	0000 4	40000 50000
							Q (sm3/d)		

Figure IV.23: Curve IPR of BDSN-02.

Genera	Deviation su	rvey Heat trar	nsfer Tubulars	Downhole equ	ipment	Artifici	al lift	Complet	ions	Surface e	quipment	
 co 	OMPLETIONS											
1	Name Geometry pro Fluid entry		Fluid entry	Top MD	Middle	MD	Bottom MD		Туре		Active	IPR model
				ft -	ft	•	ft	*	1			
1 [3RDS-2	Vertical 🔹	Single point 🔹	///////////////////////////////////////	12523,7	9	///	/////	Perfe	oration		Back press *
+												
Reserv	voir Sand Fl	uid model										
Rese	rvoir pressure:	5827,08	psig	•						1		
Rese	rvoir temperature	e: 120	degC	-	5500							
IPR b	asis:	Gas			5000	-						
Cons	tant C:	0,001130231	sm3/d/psi^2n	n –	4500	-						
Slope	e n:	1			4000							
Use t	est data:	1			3500	-						
Test t	type:	O Multipoint	Isochronal		3000							
	Q	Pwf	Pws		2500	-						
	sm3/d -	psig	* psig	•	2000							
1	34752	1684,593	5827,08	A	1500	-						
2	37632	1148,882	5827,08	_	1000							
3	1			_	500							
5				-	C							
+				*		0		10000	q	20000 (sm3/d)	300	00

Figure IV.24: Curve IPR of BRDS-2.

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General	Deviation su	rvey Heat trai	nsfer Tubulars	Downhole equ	ipment	Artificial lift Completi		tions Surface equipm		quipment		
 co 	MPLETIONS											
N	lame	Geometry pro Fluid entry		Top MD	Middle	dle MD Botto		Bottom MD			Active	IPR model
				ft -	m	*	ft	-				
1 B	RDS-1	Vertical 🔹	Single point 🔹	///////////////////////////////////////	3969,5		///	/////	Perfo	oration		Back press 🔹
+												
Reserv	oir Sand Fl	uid model										
Reser	voir pressure:	4711,415	psig	-								
Reser	voir temperatur	e: 130	degC	•	4500							
IPR ba	asis:	Gas			4000							
Const	ant C:	41,00264	sm3/d/psi^2n	• •	3500							
Slope	n:	0,5			5500							
Use te	est data:	1			3000							
Test ty	ype:	O Multipoint	Isochronal		2500							
	Q	Pwf	Pws		2000							
	sm3/d •	psig	∗ psig	•	1500							
1	107400	3957,4	4711,415	A								
2	158280	2582,928	4711,415		1000	-						
3				_	500							
4				-	0							
+				*	Ū	0		50000	Q	100000 (sm3/d)	1500	000

Figure IV.25: Curve IPR of BRDS-01.

ieneral	Deviation sur	vey Heat tra	nsfer	Tubulars	Downhole equ	ipment	Artifici	al lift	Complet	ions	Surface	equipment	
	IPLETIONS												
Na	me O	Geometry pro	Fluid	entry	Top MD	Middle	MD	Botto	m MD	Туре		Active	IPR model
					ft 🔹	ft	*	ft	*				
1 BR	DS-EXT2 \	/ertical 🔹	Singl	e point 🔹		14673,5	6	///	/////	Perfo	ration		Back press
Reservoi	ir Sand Flu	id model											
Reservo	oir pressure:	7064,99	psi	g	-	7000							
Reservo	oir temperature	: 135	de	gC	-	6500							
IPR bas	is:	Gas				6000							
Constar	nt C:	0,6785435	sm	3/d/psi^2n	*	5500							
Slope n	1:	0,6992726				5000						\mathbf{i}	
Use tes	t data:					4500							
						.55 4000							
						¥ 3000							
						2500							·····\
						2000							
						1500							
						1000							
						500							
							0		50000	Q	10 (sm3/d)	0000	150000

Figure IV.26: Curve IPR of BRDS-Ext02.

	ey neat tran		Downhole equ	ipment	Arunci	ariiit	complet	ions	Surrace	equipment	
Name G	eometry pro	Fluid entry	Top MD	Middle	MD	Botto	m MD	Туре		Active	IPR model
			ft •	ft	*	ft					
BRD12 V	ertical 🔹	Single point	• /////////////////////////////////////	10897,3	1		/////	Perfo	oration	√	Back press.
-											
eservoir Sand Flui	d model										
	2402.005	· ·									
Reservoir pressure:	2483,895	psig	•	2400	\sim						
Reservoir temperature:	112	degC	•	2200							
IPR basis:	Gas			2000							
Constant C:	0,0004735893	sm3/d/psi^2	n *	1800					_		
Slope n:	1			1600							
Use test data:				a 1400							
				a 1200							
				- 1000							
				800							
				600							
				400							
				200							
						_			-		-
					0	500	1000	· •	1500	2000	2500
								ų	(sm3/a)		



General	Deviation surv	ey Heat trar	nsfer T	ubulars	Downhole equ	ipment	Artifici	al lift	Complet	ions	Surface	equipment	
	IPLETIONS												
Nar	me G	eometry pro	Fluid en	itry	Top MD	Middle	MD	Botto	m MD	Туре		Active	IPR model
					ft •	ft	-	ft	Ŧ	_			
1 BRI	D-15 V	ertical 🔹	Single p	point 🔹		10964,5	7	///	/////	Perfo	oration		Back press
+													
Reservoi	r Sand Flui	d model											
Reservo	ir pressure:	2481,82	psig		-								
Reservo	ir temperature:	101,72	degC		-	2400							
IPR basi	is:	Gas				2200							
Constar	nt C:	0,003316183	sm3/o	d/psi^2n	•	2000	1						
Slope n	:	1				1800							
Use test	t data:					1600							
						.5 1400							
						1200							
						1 000							
						800							
						600							\sim
						400							\
						200							
							0	1	5000		10000	15000	20000
										Q	(sm3/d)		

Figure IV.28: Curve IPR of BRD-15.

NB: For the wells BRD-15, BRD-12, and BRDS-EXT2, the constants "c" and "n" are calculated solely by the reservoir pressure due to the lack of recent well-test data.

Wells	AOF	С	Ν		
BRD-12	2956,495	0,0004735893	1		
BRD-15	20667,7	0,003316183	1		
BRDS-1	193782,1	41,00264	0,5		
BRDS-2	38570,42	0,001130231	1		
BDSN-1	109239,6	0,004569078	1		
BDSN-2	49327,01	0,002605886	1		
BRDS-Ext2	BRDS-Ext2 164435,4		0,6992726		

IV.2.4 PVT Data Inputs

In the context of simulation using PIPESIM, we employed PVT (pressure, volume, temperature) data to enhance our understanding of the fluid's behavior and accurately represent it within the simulation. By incorporating PVT data, we can enhance the model's ability to select appropriate correlations, characterize fluid properties, and predict flow behavior with greater precision.

Reservoirs						
Compositions	TAGS I	NORTH	TAGS	WEST	TAGS	MAIN
Methane	81,446	81,446	81,383	80,71869	82,453	82,453
Ethane	5,652	5,652	6,353	6,301142	6,614	6,614
Propane	2,497	2,497	2,814	2,79103	2,706	2,706
Isobutane	0,64	0,64	0,617	0,6119635	0,662	0,662
Butane	1,015	1,015	1,076	1,067217	0,897	0,897
Isopentane	0,639	0,639	0,574	0,5693145	0,51	0,51
Pentane	0,43	0,43	0,423	0,4195471	0,339	0,339
Benzene	0,103	0,103	0,128	0,1269552	0,071	0,071
Hexane	0,826	0,826	0,704	0,6982534	0,596	0,596
Toluene	0,048	0,048	0,087	0,0862898	0,079	0,079
Methylcyclohexane	0	0	0,1	0,0991837	0	0
Heptane	0,777	0,777	0,64	0,6347758	0,571	0,571
P-Xylene	0,027	0,027	0,05	0,0495919	0,054	0,054
Ethylbenzene	0,004	0,004	0,009	0,0089265	0,007	0,007
O-Xylene	0,018	0,018	0,03	0,0297551	0,027	0,027
Octane	0,698	0,698	0,578	0,5732819	0,546	0,546
Nonane	0,514	0,514	0,402	0,3987185	0,373	0,373
Decane	0,461	0,461	0,406	0,4026859	0,367	0,367
Undecane	0,366	0,366	0,323	0,3203634	0,285	0,285
Dodecane	0,291	0,291	0,257	0,2549022	0,225	0,225
Tridecane	0,253	0,253	0,228	0,2261389	0,202	0,202
Tetradecane	0,203	0,203	0,186	0,1844817	0,161	0,161
Pentadecane	0,172	0,172	0,161	0,1596858	0,137	0,137
Hexadecane	0,137	0,137	0,131	0,1299307	0,11	0,11
Heptadecane	0,133	0,133	0,129	0,127947	0,107	0,107
Octadecane	0,103	0,103	0,103	0,1021592	0,082	0,082
Nonadecane	0,075	0,075	0,075	0,0743878	0,058	0,058
Nitrogen	1,044	1,044	0,654	0,6486615	0,539	0,539
Carbon Dioxide	0,995	0,995	1,799	1,784315	0,923	0,923
neo-Pentane	0,019	0,019	0,015	0,0148776	0,014	0,014
C20+	0,414	0,414	0,388	0,3848328	0,285	0,285

 Table IV.4: Composition of reservoir fluids.

IV.2.5 Data Matching

The selection of an appropriate vertical flow correlation is crucial for building a reliable well model in PIPESIM, a reservoir simulation software. This correlation should minimize the relative error between simulated and measured well performance data. PIPESIM offers a variety of correlations to choose from.

Correlation	Wells
LedaFlow v. 1.4 3-Phase	BDSN-2
LedaFlow v. 1.4 2-Phase	BDSN-1
Gray (modified)	BRD-12
Govier, Aziz [Tulsa (Legacy 1989)]	BRD-15
Govier, Aziz & Fogarasi	BRDS-Ext2
Gomez	BRDS-2
Duns & Ros [Tulsa (Legacy 1989)]	BRDS-1

Table IV.5: Vertical flow correlations


Figure IV.29: Data Matching of BDSN-1.

ame: BRD-12 - Data matching											
escription.											
Data matching Engine console Pr	ofile results Res	ults summary									
Type to filter	O Show grid	Show plot									
Case	o show giru	O Show plot									
1 Survey data BRD12 10/07/20	AXES SERII	ES									
2 Initial VC=Agf1 Inlet Pressur	Select Bott	tom X-axis: Total	distance	▼ m	*						
3 Optimized VC=Agf1 Inlet Pr	✓ Select Left	Y-axis: Press	ire	▼ psia	*						
4 Initial VC=DR Inlet Pressure=	Select Rick	nt V-avis: None		*							
5 Optimized VC=DR Inlet Pres	E Scicer Rigi										
6 Initial VC=GA Inlet Pressure=											
7 Optimized VC=GA Inlet Pres					Data matching	: BRD-12 - Data n	natching				
3 Initial VC=Gomez1 Inlet Pres	6000										
Optimized VC=Gomez1 Inlet	j 🗿 4000										
0 Initial VC=Gomez2 Inlet Pres	ž č 2000										
1 Optimized VC=Gomez2 Inlet	▲ 2000 F										_
2 Ontimized VC_CRAVM Infet Press	0		500	1000		1500	2000	25	500	3000	
Initial VC=GRAVO Inlet Press						Total distance (m	I)				
5 Ontimized VC=GRAVO Inlet		- Initial V/C - Antifi	-l-+ D	01.005 DMC10/	0.007		Ontininal			- DMC-761 907	
5 ILL-CONDITIONED Initial VC		Initial VC=Agri II	niet Pressure=6137	22 nsia RMS=104	10,097	v 	Optimized	VC=Agri iniel Pres VC=DR Inlet Pres	essure=5920.000 ps sure=5958 228 nsia	BMS=812.097	
7 Optimized VC=ORK Inlet Pre		 Initial VC=DK Initial VC=GA Ini	et Pressure=6101	.931 psia RMS=104	.09	J	Optimized	VC=DR Inlet Pres	sure=5928.88 psia F	RMS=012,05	
8 Initial VC=TDR Inlet Pressure	V	 Initial VC=Gome 	z1 Inlet Pressure=	:5739.743 psia RMS=	401,365	v	Optimized	VC=Gomez1 Inlet	t Pressure=5595.146	psia RMS=55,177	
9 Optimized VC=TDR Inlet Pre	V	- Initial VC=Gome	z2 Inlet Pressure=	5739.743 psia RMS=	401,365	/	Optimized	VC=Gomez2 Inlet	t Pressure=5595.146	psia RMS=55,177	
	J	Initial VC=GRAYN	V Inlet Pressure=	5567 606 neia RMS-	115.869	J	Optimized	VC=GRAYM Inlet	Pressure=5591.369	psia RMS=42,802	
20 Initial VC=IGA Inlet Pressure	L		n meen ressure-	5501,000 paid ((M))-	110,000	-					
20 Initial VC=TGA Inlet Pressure 21 Optimized VC=TGA Inlet Pres	<u></u>	 Initial VC=GRAYC 	D Inlet Pressure=5	5567.604 psia RMS=1	15,875	V	Optimized	VC=GRAYO Inlet	Pressure=5591.366	psia RMS=42,811	
20 Initial VC=TGA Inlet Pressure 21 Optimized VC=TGA Inlet Press 22 ILL-CONDITIONED Initial VC		 Initial VC=GRAYC ILL-CONDITIONE 	D Inlet Pressure=5	5567.604 psia RMS=1 Inlet Pressure=6162	15,875 .714 psia RMS=11	32,297 V	Optimized Optimized	VC=GRAYO Inlet VC=ORK Inlet Pre	Pressure=5591.366 essure=6057.807 psi	, psia RMS=42,811 a RMS=972,894	
20 Initial VC=IGA Iniet Pressure 21 Optimized VC=TGA Iniet Pres 22 ILL-CONDITIONED Initial VC 23 Optimized VC=TORK Inlet Pr	✓ ✓ ✓ ✓	Initial VC=GRAYC ILL-CONDITIONE Initial VC=TDR Ir	D Inlet Pressure=5 D Initial VC=ORK nlet Pressure=613	5567.604 psia RMS= 101 Inlet Pressure=6162 103 psia RMS=1094 104 psia RMS=097	15,875 .714 psia RMS=11 .081	32,297 V	Optimized Optimized Optimized	VC=GRAYO Inlet VC=ORK Inlet Pre VC=TDR Inlet Pre	Pressure=5591.366 essure=6057.807 psi essure=5957.93 psia	, psia RMS=42,811 a RMS=972,894 RMS=811,587	
Initial VC=IGA Inite Pressure Optimized VC=TGA Inite Pres ILL-CONDITIONED Initial VC Optimized VC=TORK Inlet Pr		Initial VC=GRAYC ILL-CONDITIONE Initial VC=TDR Ir Initial VC=TGA Ir	D Inlet Pressure=5 D Initial VC=ORK Net Pressure=613 Net Pressure=606	5567.604 psia RMS= 101et Pressure=6162 7.03 psia RMS=1094 7.498 psia RMS=987	15,875 .714 psia RMS=11 .081 .927	32,297 V V	Optimized Optimized Optimized Survey data	VC=GRAYO Inlet VC=ORK Inlet Pre VC=TDR Inlet Pre BRD12 10/07/20	Pressure=5591.366 essure=6057.807 psi essure=5957.93 psia 023 00:00:28	psia RMS=42,811 a RMS=972,894 RMS=811,587	
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20 Initial VC= IGA linket Pressure 21 Optimized VC=TGA linket Pressure 22 ILL-CONDITIONED Initial VC 23 Optimized VC=TORK linket Pr 24 BRD-12 - Data matching 25 BRD-12 - Data matching 26 Engine console 27 Profi 28 Figure console 29 Filter Vertical multiphase correlation Gray (modified) Gray (original) Gomez Govier, Aziz (Tulsa (Legacy 1989)] Aziz Govier, Fogarasi Govier, Aziz & Fogarasi Duns & Ros [Baker Jardine] Duns & Ros [Baker Jardine]	↓ ↓ ↓ ↓	Initial VC=GRAYC ILL-CONDITIONE Initial VC=TGA Ir ILEG3827 ILEG38	Calibrated Unlet Pressure=5 ED Initial VC=ORK Initial VC=ORK Initi	Initial pressure 7.03 psia RMS=1094 7.03 psia RMS=1094 7.498 psia RMS=1094 7.2.014754 72.020554 366.913396 962.041834 1015.56738 1015.761733 1069.358301 1069.645296	IS.875 15.875 .714 psia RMS=11 081 927 Calibrated pressure RMS 0.344823 0.353187 10.584329 10.584329 664.260979 732.062857 732.136033 782.373375 782.883303	Initial Imitial Imitial <td< td=""><td>Calibrated Coptimized Survey data Survey data Calibrated temperature RMS 42.457425 44.592463 30.974659 29.834328 29.833479 29.21359 29.207069</td><td>VC=GRAYO Inlet VC=ORK Inlet Pre VC=TDR Inlet Pre BRD12 10/07/2C ANDE RMS 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Pressure=5591.366 sessure=5597.307 psi sessure=5957.93 psia sessure=5957.93 psia 23 0.00.28 24 0.00.28 25 0.00.28 26 0.00.28 27 0.00.28 28 0.00.28 29 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28</td><td>pia RMS=42.811 a RMS=972.894 RMS=811.587 Initial total RMS 115.868881 115.874825 401.365368 987.92724 1040.897295 1041.08963 1094.081435 1094.081435</td><td>Calibr total RMS 42.800 42.810 55.177 695.22 761.80 761.90 811.50 812.00</td></td<>	Calibrated Coptimized Survey data Survey data Calibrated temperature RMS 42.457425 44.592463 30.974659 29.834328 29.833479 29.21359 29.207069	VC=GRAYO Inlet VC=ORK Inlet Pre VC=TDR Inlet Pre BRD12 10/07/2C ANDE RMS 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Pressure=5591.366 sessure=5597.307 psi sessure=5957.93 psia sessure=5957.93 psia 23 0.00.28 24 0.00.28 25 0.00.28 26 0.00.28 27 0.00.28 28 0.00.28 29 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28 20 0.00.28	pia RMS=42.811 a RMS=972.894 RMS=811.587 Initial total RMS 115.868881 115.874825 401.365368 987.92724 1040.897295 1041.08963 1094.081435 1094.081435	Calibr total RMS 42.800 42.810 55.177 695.22 761.80 761.90 811.50 812.00
20 Initial VC= IGA Initel Pressure 21 Optimized VC=TGA Initel Pres 22 ILL-CONDITIONED Initial VC 23 Optimized VC=TORK Initel Pr 23 Optimized VC=TORK Initel Pr 24 Initial Pressure Pr	Calibrated vertical friction factor 1.23335 2 2 0.608914 0.612603 0.609256 1.371952 1.371952	Initial VC=GRAYC ILL-CONDITIONE Initial VC=TGA Ir Initial VC=TGA Ir Calibrated vertical holdup factor 1.263827 1.263827 1.263827 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	Calibrated Unlet Pressure=5 ED Initial VC=ORK Initial VC=ORK Initi	Initial pressure 7.03 psia RMS=1094 7.03 psia RMS=1094 7.498 psia RMS=1094 7.2020554 366.913396 366.913396 962.041834 1015.56738 1015.761733 1069.358301 1069.645296 1107.891883 1405.91883	IS.875 15.875 .714 psia RMS=11 081 927 Calibrated pressure RMS 0.344823 0.353187 10.584329 10.584329 664.260979 732.062857 732.136033 782.373375 782.883303 946-706747	Initial Initial temperature RMS 43.854127 43.854271 34.451972 25.85406 25.327898 24.723134 24.72002 24.723034 24.72002 24.72002	Calibrated Coptimized Optimized Survey data Calibrated temperature RMS 42.45722 42.457425 44.592463 30.974659 29.834328 29.833479 29.21359 29.207069 29.207069 26.187494	VC=GRAYO Inlet VC=ORK Inlet Pre VC=TDR Inlet Pre BRD12 10/07/20 ARD12 10/07/20 AR	Pressure=5591.366 essure=5057.807 psi essure=5957.93 psia 23 00:00:28	Initial Initial total RMS=811,587 Initial total RMS 115,874825 401,365368 987,92724 1040,897295 1041,08963 1094,081435 1094,081316 112,297273	Calibra total RMS 42.802 42.810 55.176 695.23 761.96 811.58 812.09 972.89

Figure IV.30: Data Matching of BRD-12.

	a matching											
Name: Descri	BRDS-Ext2 - Data matching											
Data	natching Engine console Profi	le results Results	summary									
Type t	o filter	Show grid 💿 S	how plot									
	Case											
1	Survey data BRDSext2 17/10	Select Bottom	Y-avic Pressure			•						
3	Optimized VC=Agf1 Inlet Pr	Select Left Y-a	vis Elevation		+ ft	*						
4	Initial VC=DR Inlet Pressure=	Select Right Y-	-axis: None	·	*							
5	Optimized VC=DR Inlet Pres											
7	Optimized VC=GA Inlet Pressure=					Data matching :	RPDS Evet 2 Data	matching				
8	Initial VC=Gomez1 Inlet Pres	0				Data matching .	BRD3-EXIZ - Data					
9	Optimized VC=Gomez1 Inlet	5000										
10	Initial VC=Gomez2 Iniet Pres Optimized VC=Gomez2 Inlet	-10000										
12	Initial VC=GRAYM Inlet Press	-15000										
13	Optimized VC=GRAYM Inlet		1200 1400	1600 18	300 2000 2	200 2400	2600 2800 Pressure (psig	3000 3 I)	200 3400	3600 3800	4000 420	10 4400
14	Initial VC=GRAYO Inlet Press											
16	Initial VC=TDR Inlet Pressure		Initial	VC=Agf1 Inlet F VC=DR Inlet Pre	ressure=4214.67 ps essure=4413.303 ps	a RMS=104,742 a RMS=256.873	J	Optimize Optimize	d VC=Agf1 Inlet d VC=DR Inlet P	Pressure=4131.352 ressure=4136.829 r	2 psia RMS=54,548 psia RMS=54,786	
17	Optimized VC=TDR Inlet Pre	<u>_</u>	Initial	VC=GA Inlet Pre	essure=4217.831 ps	a RMS=107,153	v	Optimize	d VC=GA Inlet P	ressure=4144.37 ps	ia RMS=18,283	
18	Initial VC=TGA Inlet Pressure		Initial	VC=Gomez1 Inl	et Pressure=3315.5	53 psia RMS=689,	236	Optimize	d VC=Gomez1 li	nlet Pressure=4063	647 psia RMS=99,0	24
19	Optimized VC=IGA inlet Pre	<u>_</u>	Initial	VC=GOMEZ2 IN VC=GRAYM Inle	et Pressure=3315.5 et Pressure=2724.64	53 psia RMS=689, 7 psia RMS=1194	.148 🖌 🗕	Optimize Optimize	d VC=Gomezz II d VC=GRAYM In	let Pressure=4063 let Pressure=3180.8	647 psia KMS=99,0 378 psia RMS=806,0	24
		<u>_</u>	Initial	VC=GRAYO Inle	t Pressure=2724.63	5 psia RMS=1194,	159 🖌 🗕	Optimize	d VC=GRAYO In	et Pressure=3180.8	34 psia RMS=806,0	6
			Initial Initial	VC=TDR Inlet P	ressure=4412.817 p	sia RMS=256,5	J	Optimize	d VC=TDR Inlet	Pressure=4136.133	psia RMS=54,648	
		A	mua	VC=TOA IIIet II	1e3501e=4145.245 p	51d IXIVI3-34,403	W	Optimize	u vo=ruA iniet	11e35u1e=4144,125	psia ((WD=10,004	
		1	 Survey 	y data BRDSext2	17/10/2023 00:00:	5						
		1	 Survey 	y data BRDSext2	17/10/2023 00:00:	5						
N Da		4	 Survey 	y data BRDSext2	2 17/10/2023 00:00:	5						
📐 Da	ta matching	4	Survey	y data BRDSext2	17/10/2023 00:00:	5						□ >
📐 Da Nam	ta matching e: BRDS-Ext2 - Data matching	4	Survey	y data BRDSext2	17/10/2023 00:00:							
Nam Desc	ta matching e: BRDS-Ext2 - Data matching iption:	↓	Survey	y data BRDSext2	17/10/2023 00:00:	5						
Nam Desc	ta matching e: BRDS-Ext2 - Data matching iption:	, € I	Survey	y data BRDSext2	17/10/2023 00:00:	.5						
Nam Desc Data	ta matching e: BRDS-Ext2 - Data matching iption: matching Engine console Pro	ofile results Resul	Survey	y data BRDSext2	17/10/2023 00:00:							
Nam Desc Data	ta matching e: BRDS-Ext2 - Data matching iption: matching Engine console Pro	ville results Result	Survey	y data BRDSext2	17/10/2023 00:00:							
Nam Desc Data	ta matching BRDS-Ext2 - Data matching iption: matching Engine console Pro to filter Vertical multiphase correlation	ofile results Result	Survey	y data BRDSext2	17/10/2023 00:00:	Calibrated	Initial	Calibrated	Initial	Calibrated	Initial	Calibrated
Nam Desc Data	ta matching e: BRDS-Ext2 - Data matching iption: matching Engine console Pro to filter Vertical multiphase correlation	file results Resul	Survey Survey ts summary Calibrated vertical	y data BRDSext2 Calibrated U value	IT7/10/2023 00:00: Initial pressure	Calibrated pressure	Initial temperature	Calibrated temperature	Initial holdup	Calibrated holdup	Initial total	Calibrated total
Nam Desc Type	ta matching e: BRDS-Ext2 - Data matching iption: matching Engine console Pro to filter Vertical multiphase correlation	vfile results Result Calibrated vertical friction factor	Survey Survey Survey Survey Calibrated vertical holdup factor	y data BRDSext2 Calibrated U value multiplier	Initial pressure RMS	Calibrated pressure RMS	Initial temperature RMS	Calibrated temperature RMS	Initial holdup RMS	Calibrated holdup RMS	Initial total RMS	Calibrated total RMS
Nam Desc Data	ta matching e: BRDS-Ext2 - Data matching iption:	Calibrated vertical friction factor 1.096869	Survey Survey Survey Calibrated vertical holdup factor 1.02395	Calibrated U value multiplier 0.12217	Initial pressure RMS 66.340324	S Calibrated pressure RMS 13.374009	Initial temperature RMS 40.812787	Calibrated temperature RMS 4.90937	Initial holdup RMS 0	Calibrated holdup RMS 0	Initial total RMS 107.153111	Calibrated total RMS 18.283379
Nam Desc Data Type	ta matching e: BRDS-Ext2 - Data matching iption: matching Engine console Pro to filter Vertical multiphase correlation Govier, Aziz & Fogarasi Govier, Aziz [Tulsa (Legacy 1989)]	Calibrated vertical friction factor 1.096869 0.941719	Survey Survey Survey Calibrated vertical holdup factor 1.02395 1.130525	v data BRDSext2 Calibrated U value multiplier 0.12217 0.121156	Initial pressure RMS 66.340324 13.8447	S Calibrated pressure RMS 13.374009 13.279098	Initial temperature RMS 40.812787 40.644243	Calibrated temperature RMS 4.90937 5.275344	Initial holdup RMS 0 0	Calibrated holdup RMS 0 0	Initial total RMS 107.153111 54.488943	Calibrated total RMS 18.283379 18.554442
Data	ta matching EXAMPLE A Constraints EXAMPLE A	Calibrated vertical friction factor 1.096869 0.941719 1.004737	Calibrated vertical holdup factor 1.02395 1.130525 0.850777	Calibrated U value multiplier 0.12217 0.121156 3.390987	Initial pressure RMS 66.340324 1.3.8447 6.3.929768	 S Calibrated pressure RMS 13.374009 13.279098 10.184785 	Initial temperature RMS 40.812787 40.644243 40.812225	Calibrated temperature RMS 4.90937 5.275344 44.363008	Initial holdup RMS 0 0 0 0	Calibrated holdup RMS 0 0 0 0 0	Initial total RMS 107.153111 54.488943 104.741993	Calibrated total RMS 18.283379 18.554442 54.547793
Data	ta matching BRDS-Ext2 - Data matching iption: matching Engine console Pro to filter Vertical multiphase correlation Govier, Aziz & Fogarasi Govier, Aziz [Tulsa (Legacy 1989)] Aziz Govier Fogarasi Duns & Ros [Tulsa (Legacy 1989)]	file results Result offile results Result Calibrated vertical friction factor 1.096869 0.941719 1.004737 1.663386	Calibrated vertical holdup factor 1.02395 1.130525 0.850777 0.547852	y data BRDSext2 Calibrated U value multiplier 0.12217 0.121156 3.390987 8.191339	Initial pressure RMS 66.340324 13.8447 63.929768 215.666847	Calibrated pressure RMS 13.374009 13.279098 10.184785 10.4049	Initial temperature RMS 40.812787 40.644243 40.812225 40.833336	Calibrated temperature RMS 4.90937 5.275344 44.363008 44.243596	Initial holdup RMS 0 0 0 0 0	Calibrated holdup RMS 0 0 0 0 0 0	Initial total RMS 107.153111 54.488943 104.741993 256.500183	Calibrated total RMS 18.283379 18.554442 54.547793 54.648496
Nam Desc Data Type 1 2 3 4 5	ta matching BRDS-Ext2 - Data matching iption: matching Engine console Pro to filter Vertical multiphase correlation Govier, Aziz & Fogarasi Govier, Aziz [Tulsa (Legacy 1989)] Aziz Govier Fogarasi Duns & Ros [Tulsa (Legacy 1989)] Duns & Ros [Baker Jardine]	Calibrated vertical friction factor 0.941719 1.004737 1.663386 1.663386	Survey	2 Calibrated U value multiplier 0.12217 0.121156 3.390987 8.191339 8.191339	Initial pressure RMS 66.340324 13.8447 63.929768 215.666847 216.039011	Sis Calibrated pressure RMS 13.374009 13.279098 10.184785 10.4049 10.542252	Initial temperature RMS 40.812787 40.644243 40.812225 40.83336 40.833523	Calibrated temperature RMS 4.90937 5.275344 44.363008 44.243596 44.243597	Initial holdup RMS 0 0 0 0 0 0 0 0 0	Calibrated holdup RMS 0 0 0 0 0 0 0 0 0	Initial total RMS 107.153111 54.488943 104.741993 256.500183 256.872534	Calibrated total RMS 18.283379 18.554442 54.547793 54.648496 54.785849
Nam Desc Data Type 1 2 3 4 5 6	ta matching BRDS-Ext2 - Data matching iption: matching Engine console Pro to filter Vertical multiphase correlation Govier, Aziz & Fogarasi Govier, Aziz [Tulsa (Legacy 1989)] Aziz Govier Fogarasi Duns & Ros [Tulsa (Legacy 1989)] Duns & Ros [Baker Jardine] Gomez	Calibrated vertical friction factor 1.096869 0.941719 1.004737 1.663386 1.563386 0.5	Calibrated vertical holdup factor 1.02395 1.130525 0.850777 0.547852 0.547852 2	Calibrated U value multiplier 0.12217 0.121156 3.390987 8.191339 8.191339 9.965021	Initial pressure RMS 66.340324 13.8447 63.929768 215.666847 216.039011 650.198419	Calibrated pressure RMS 13.374009 13.279098 10.184785 10.4049 10.542252 54.819418	Initial temperature RMS 40.812787 40.644243 40.812225 40.83336 40.833523 39.037689	Calibrated temperature RMS 4.90937 5.275344 44.363008 44.243596 44.243597 44.204794	Initial holdup RMS 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Calibrated holdup RMS 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Initial total RMS 107.153111 54.488943 104.741993 256.500183 256.872534 689.236108	Calibrated total RMS 18.283379 18.554442 54.547793 54.648496 54.785849 99.024212
Nam Desc Data Type 1 2 3 4 5 6 7	ta matching e: BRDS-Ext2 - Data matching iption: matching Engine console Pro to filter Vertical multiphase correlation Govier, Aziz & Fogarasi Govier, Aziz [Tulsa (Legacy 1989)] Aziz Govier Fogarasi Duns & Ros [Tulsa (Legacy 1989)] Duns & Ros [Baker Jardine] Gomez Gomez Gomez Enhanced	Calibrated vertical friction factor 1.096869 0.941719 1.663386 1.663386 0.5 0.5	Calibrated vertical holdup factor 1.02395 1.130525 0.850777 0.547852 2 2 2	Calibrated U value multiplier 0.12217 0.121156 3.390987 8.191339 8.191339 9.965021 9.965021	Initial pressure RMS 66.340324 13.8447 63.929768 215.666847 215.666847 216.039011 650.198419 650.198419	Sis Calibrated pressure RMS 13.374009 13.279098 10.184785 10.4049 10.542252 54.819418 54.819418	Initial temperature RMS 40.812787 40.644243 40.813225 40.833336 40.833323 39.037689 39.037689	Calibrated temperature RMS 4.90937 5.275344 44.363008 44.243596 44.243597 44.204794 44.204794	Initial holdup RMS 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Calibrated holdup RMS 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Initial total RMS 107.153111 54.488943 104.741993 256.500183 256.872534 689.236108 689.236108	Calibrated total RMS 18.283379 18.554442 54.547793 54.648496 54.785849 99.024212 99.024212
Nam Desc Data Type 1 2 3 4 5 6 7 8	ta matching BRDS-Ext2 - Data matching matching Engine console Pro to filter Vertical multiphase correlation Govier, Aziz & Fogarasi Govier, Aziz (Tulsa (Legacy 1989)) Aziz Govier Fogarasi Duns & Ros [Tulsa (Legacy 1989)] Duns & Ros [Baker Jardine] Gomez Gomez Enhanced Gray (modified)	Calibrated vertical friction factor 1.096869 0.941719 1.663386 1.663386 0.5 0.5 2	Calibrated vertical holdup factor 1.02395 1.130525 0.850777 0.547852 2 2 2 2 2 2	Calibrated U value multiplier 0.12217 0.121156 3.390987 8.191339 9.965021 9.965021 8.040466	Initial pressure RMS 66.340324 13.8447 63.929768 215.666847 215.666847 215.666847 215.666847 650.198419 650.198419 156.146316	Sis Calibrated pressure RMS 13.374009 13.279098 10.184785 10.484785 10.4049 10.484785 54.819418 54.819418 761.748083	Initial temperature RMS 40.812787 40.644243 40.81225 40.833326 40.833523 39.037689 39.037689 39.037689 38.001541	Calibrated temperature RMS 4.90937 5.275344 44.363008 44.243596 44.243597 44.204794 44.204794 44.204794 44.274662	Initial holdup RMS 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Calibrated holdup RMS 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Initial total RMS 107.153111 54.48943 104.741993 256.500183 256.872534 689.236108 689.236108 689.236108	Calibrated total RMS 18.283379 18.554442 54.547793 54.648496 54.785849 99.024212 99.024212 99.024212
Nam Desc Data Type 1 2 3 4 5 6 7 8 9	ta matching BRDS-Ext2 - Data matching iption: matching Engine console Pro to filter Vertical multiphase correlation Govier, Aziz & Fogarasi Govier, Aziz (Tulsa (Legacy 1989)] Aziz Govier Fogarasi Duns & Ros [Tulsa (Legacy 1989)] Duns & Ros [Baker Jardine] Gomez Gomez Enhanced Gray (modified) Gray (criginal)	Image: Calibrated vertical friction factor 1.096869 0.941719 1.004737 1.663386 0.5 0.5 2 2 2	 Survey Survey	Calibrated U value multiplier 0.12217 0.121156 3.390987 8.191339 8.191339 9.965021 9.965021 8.040466 8.040466	Initial pressure RMS 66.340324 13.8447 63.929768 215.666847 215.66847215.65847 215.6584721	Sis Calibrated pressure RMS 13.374009 13.374009 13.279098 10.184785 10.4049 10.542252 54.819418 54.819418 761.748083 761.784861	Initial temperature RMS 40.812287 40.644243 40.812225 40.83336 40.833523 39.037689 39.037689 39.037689 38.001541 38.00152	Calibrated temperature RMS 4.90937 5.275344 44.363008 44.243596 44.243597 44.204794 44.204794 44.204794 44.274662 44.274663	Initial holdup RMS 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Calibrated holdup RMS 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Initial total RMS 107.153111 54.488943 104.741993 256.500183 256.872534 689.236108 689.236108 1194.147857 1194.158642	Calibrated total RMS 18.283379 18.554442 54.547793 54.648496 54.785849 99.024212 99.024212 99.024212 806.022745 806.025954
Nam Desc Data Type 1 1 2 3 4 5 6 7 8 9	ta matching BRDS-Ext2 - Data matching iption: matching Engine console Pro to filter Vertical multiphase correlation Govier, Aziz & Fogarasi Govier, Aziz (Tulsa (Legacy 1989)] Aziz Govier Fogarasi Duns & Ros [Tulsa (Legacy 1989)] Duns & Ros [Baker Jardine] Gomez Gomez Enhanced Gray (modified) Gray (original)	Image: Calibrated vertical friction factor 1.096869 0.941719 1.004737 1.663386 0.5 0.5 2 2 2 4	 Survey Survey	v data BRDSext2 Calibrated U value multiplier 0.12217 0.121156 3.390987 8.191339 8.191339 9.965021 9.965021 8.040466 8.040466	Initial pressure RMS 66.340324 13.8447 63.929768 215.666847 216.039011 650.198419 650.198419 1156.146316 1156.157122	Calibrated pressure RMS 13.374009 13.279098 10.184785 10.4049 10.542252 54.819418 54.819418 761.748083 761.748083	Initial temperature RMS 40.812787 40.644243 40.812225 40.833326 40.833523 39.037689 39.037689 38.001541 38.00152	Calibrated temperature RMS 4.90937 5.275344 44.363008 44.243596 44.243597 44.204794 44.204794 44.204794 44.274662 44.274663	Initial holdup RMS 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Calibrated holdup RMS 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Initial total RMS 107.153111 54.48943 104.741993 256.500183 256.872534 689.236108 689.236108 1194.147857 1194.158642	Calibrated total RMS 18.283379 18.554442 54.547793 54.648496 54.785849 99.024212 99.024212 806.022745 806.059524
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Nam Desc Data Type 1 2 3 4 5 6 7 7 8 9	ta matching BRDS-Ext2 - Data matching iption: matching Engine console Pro to filter Vertical multiphase correlation Govier, Aziz & Fogarasi Govier, Aziz [Tulsa (Legacy 1989)] Aziz Govier Fogarasi Duns & Ros [Tulsa (Legacy 1989)] Duns & Ros [Baker Jardine] Gomez Gomez Enhanced Gray (modified) Gray (original)	Calibrated vertical frition factor 1.096869 0.941719 1.663386 1.663386 0.5 0.5 2 2 2 2	 Survey Survey Survey Calibrated vertical holdup factor 1.02395 1.130525 0.850777 0.547852 0.547852 2 3 	Calibrated U value multiplier 0.12217 0.121156 3.390987 8.191339 9.965021 9.965021 9.965021 8.040466 8.040466	Initial pressure RMS 66.340324 13.8447 63.929768 215.666847 216.039011 650.198419 650.198419 1156.146316 1156.146316	Image: Signame and	Initial temperature RMS 40.812787 40.644243 40.833336 40.833523 39.037689 39.037689 38.00152	Calibrated temperature RMS 4.90937 5.275344 44.363008 44.243596 44.243597 44.204794 44.204794 44.274662 44.274663	Initial holdup RMS 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Calibrated holdup RMS 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Initial total RMS 107.153111 54.488943 104.741993 256.500183 256.872534 689.236108 689.236108 689.236108 1194.147857 1194.158642	Calibrated total RMS 18.283379 18.554442 54.547793 54.648496 54.785849 99.024212 99.024212 99.024212 806.022745 806.0259524

Figure IV.31: Data Matching of Ext-2.

a matching Engine console Pro											
a matching Engine console Pro											
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to filter Case Survey data BRDS2 26/06/20 Initial VC=Agf1 Outlet Pressur Optimized VC=Agf1 Outlet Pressur Optimized VC=DR Outlet Pressur Optimized VC=GA Outlet Pressur Optimized VC=GA Outlet Pressur Optimized VC=GA Outlet Pressur Optimized VC=GOmez1 Outl Initial VC=GRAYM Outlet Pre Optimized VC=GRAYO Outlet Pre Optimized VC=GRAYO Outlet Pre Optimized VC=GRAYO Outlet Pre Optimized VC=TDR Outlet Pre Optimized VC=TDR Outlet Pre Optimized VC=TGA Outlet Pre	Show grid AXES SERIES Select Botton Select Left Y- Select Right V (1) (2) (2) (2) (2) (3) (4) (4) (4) (4) (4) (4) (4	Show plot In X-axis: Pressure axis: Elevatio Y-axis: None 500 Initial VC Inital VC Inital VC Initial VC Inital VC IN	n 1000 E=Agf1 Outlet Pre E=GA Outlet Pre E=Gome21 Outle E=GRAYM Outlet E=GRAYO Outlet E=TGR Outlet Pre TGR Outlet Pre TGR Outlet Pre	psig ft ft	Data matching Data matching 2000 250 iia RMS=608,094 ia RMS=603,69 ia RMS=604,445 206 psia RMS=569,70 6 psia RMS=567,71 1 psia RMS=567,71 1 psia RMS=567,71 sia RMS=567,77 sia RMS=567,77 sia RMS=567,77 sia RMS=567,77 sia RMS=567,79 sia RMS=567,89 sia RMS=569,89	g : BRDS-2 - Data 0 3000 Pressure (ps 0 0 0 0 0 0 0 0 0 0 0 0 0	matching ig) Optimize O	4000 ed VC=Agf1 Ou ed VC=DR Outle ed VC=GA Outle ed VC=GA0utle ed VC=GRAYM ed VC=GRAYO (ed VC=GRAYO (ed VC=TDR Out ed VC=TDR Out	4500 tlet Pressure=319.9 tt Pressure=337.366 tt Pressure=334.587 Outlet Pressure=45 Outlet Pressure=507 Dutlet Pressure=2377.15 tet Pressure=2377.15	5000 5 101 psia RMS=554, 5 psia RMS=571.04' 1 psia RMS=552.3 14.3068 psia RMS=4 1.3435 psia RMS=4 1.3435 psia RMS=5 1.3731 psia RMS=5 1.37	221 5 03 543,543 543,545 47,725 47,726 97 06
	1	 Survey d 	iata BRDS2 26/0	0/2023 00.00.13							
Data matching ne: BRDS-2 - Data matching cription: ta matching Engine console Pr	ofile results Resul	Survey of	lata BRDS2 26/0	0/2023 00:00.13							C
ata matching ne: BRDS-2 - Data matching cription: ta matching Engine console Pr e to filter Vertical multiphase correlation	ofile results Resul	Survey of	Calibrated U value	Initial	Calibrated	Initial temperature	Calibrated temperature	Initial holdup	Calibrated holdup	Initial total	Calibra total
ata matching e: BRDS-2 - Data matching ription: a matching Engine console Pr e to filter Vertical multiphase correlation	ofile results Resul Calibrated vertical friction factor	Survey of	Calibrated U value multiplier	Initial pressure RMS	Calibrated pressure RMS	Initial temperature RMS	Calibrated temperature RMS	Initial holdup RMS	Calibrated holdup RMS	Initial total RMS	Calibra total RMS
ata matching e: BRDS-2 - Data matching ription:	ofile results Results Calibrated vertical friction factor 1.936246	Survey of	Calibrated U value multiplier 0.191989	Initial pressure RMS 535.245454	Calibrated pressure RMS 533.308634	Initial temperature RMS 34.714489	Calibrated temperature RMS 10.084845	Initial holdup RMS 0	Calibrated holdup RMS 0	Initial total RMS 569.959943	Calibra total RMS 543.39
ata matching e: BRDS-2 - Data matching ription: a matching Engine console Pr to filter Vertical multiphase correlation Gomez Gomez Enhanced	Calibrated vertical friction factor 1.936246 1.634969	Survey of	Calibrated U value multiplier 0.191989 0.186389	Initial pressure RMS 535.245454 535.245451	Calibrated pressure RMS 533.308634 533.338877 533.442777	Initial temperature RMS 34.714489 34.714489	Calibrated temperature RMS 10.084845 10.205952	Initial holdup RMS 0 0	Calibrated holdup RMS 0 0	Initial total RMS 569.959943 569.95994	Calibra total RMS 543.39 543.54
ata matching e: BRDS-2 - Data matching ription: a matching Engine console Pr a matching Engine console Pr e to filter Vertical multiphase correlation Gomez Gomez Enhanced Gray (modified)	ofile results Results Calibrated vertical friction factor 1.936246 1.634969 0.804543 0.804543 0.904543	Survey of	Calibrated U value multiplier 0.191989 0.186389 0.133383	Initial pressure RMS 535.245454 533.235266	Calibrated pressure RMS 533.308634 533.338877 533.443787	Initial temperature RMS 34.714489 34.52851	Calibrated temperature RMS 10.084845 10.205952 14.281371	Initial holdup RMS 0 0 0 0	Calibrated holdup RMS 0 0 0 0	Initial total RMS 569.959943 567.763776	Calibra total RMS 543.39 543.54
ata matching e: BRDS-2 - Data matching rription: Engine console Pr a matching Engine console Pr e to filter Vertical multiphase correlation Gomez Gomez Enhanced Gray (modified) Gray (original)	ofile results Results Calibrated vertical friction factor 1.936246 1.634969 0.804543 0.804543 0.804543	Survey c Survey c Survey c Survey c	Calibrated U value multiplier 0.191989 0.186389 0.133383 0.133383	Initial pressure RMS 535.245454 533.245451 533.235266 533.236685	Calibrated pressure RMS 533.308634 533.38877 533.4443787 533.4443787	Initial temperature RMS 34.714489 34.52851 34.528308	Calibrated temperature RMS 10.084845 10.205952 14.281371 14.281736	Initial holdup RMS 0 0 0 0	Calibrated holdup RMS 0 0 0 0 0 0	Initial total RMS 569.959943 567.763776 567.762992	Calibra total RMS 543.54 547.72 547.72
ata matching e: BRDS-2 - Data matching rription:	Calibrated vertical friction factor 1.936246 1.634969 0.804543 0.804543 0.5	Survey of	Calibrated U value multiplier 0.191989 0.186389 0.133383 0.190171	Initial pressure RMS 535.245451 533.235266 533.234685 562.19584	Calibrated pressure RMS 533.308634 533.338877 533.443787 533.444524 538.222239	Initial temperature RMS 34.714489 34.52851 34.528308 35.293063	Calibrated temperature RMS 10.084845 10.205952 14.281371 14.281736 9.983437	Initial holdup RMS 0 0 0 0 0 0 0	Calibrated holdup RMS 0 0 0 0 0 0 0 0 0 0	Initial total RMS 569.959943 569.35994 567.763776 567.763776 567.762992 597.488903	Calibra total RMS 543.39 543.54 547.72 547.72 548.20
ata matching e: BRDS-2 - Data matching rription: Engine console Pr a matching Engine console Pr a to filter Vertical multiphase correlation Gomez Enhanced Gray (modified) Gray (original) Govier, Aziz [Tulsa (Legacy 1989) Govier, Aziz & Fogarasi	Spile results Results Calibrated vertical friction factor 1.936246 1.634969 0.804543 0.804543 0.5 0.750637 1.936246	Survey c Survey c Survey c Survey c	Calibrated U value multiplier 0.191989 0.186389 0.133383 0.133383 0.190171 0.178781	Initial pressure RMS 535.245454 533.235266 533.235266 533.234685 562.19584 569.142137	Calibrated pressure RMS 533.308634 533.338877 533.443787 533.444524 538.222239 542.248242	Initial temperature RMS 34.714489 34.52851 34.528308 35.293063 35.302726	Calibrated temperature RMS 10.084845 10.205952 14.281371 14.281736 9.983437 10.055182	Initial holdup RMS 0 0 0 0 0 0 0 0 0 0	Calibrated holdup RMS 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Initial total RMS 569.959943 569.55994 567.763776 567.762992 597.488903 604.444863	Calibra total RMS 543.39 543.54 547.72 547.72 548.20 552.30
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Figure IV.32: Data Matching of BRDS-2.

Modeling and Forecasting of the Impact of the Booster on Candidate Wells

ne: BDSN-2 - Data matching											
cription:											
ta matching Engine concolo Profi	ile results - Resul	to cumpany									
ta matching Engine console Profi	ne results Resul	is summary									
e to filter	Show grid 💿	Show plot									
Case											
Survey data BDSN2 21/06	AXES SERIES										
Initial VC=Agf1 Outlet Pr	Select Botto	m X-axis: Pressur	e	• psig	*						
Optimized VC=Agf1 Outl	✓ Select Left Y	-axis: Elevati	on	+ ft	*						
Initial VC=DR Outlet Pres	Select Right	V-avis: None									
Optimized VC=DR Outlet		T-dxis. INOTIC									
Initial VC=GA Outlet Pres											
Optimized VC=GA Outlet					Data matchin	g : BDSN-2 - Data	a matching				
Initial VC=Gomez1 Outlet	0		<u> </u>								
Optimized VC=Gomez1	5000										
Initial VC=Gomez2 Outlet	S.E.										
Optimized VC=Gomez2	■ -10000										
Initial VC=GRAYM Outlet	_	500	1000	1500	20	000	2500	3000	3500	4000	
Optimized VC=GRAYM O						Pressure (ps	ig)				
Initial VC=GRAYO Outlet											
Initial VC=HPP Outlet Pre		Initial V	/C=Agf1 Outlet I	Pressure=349.1624	psia RMS=379,796	5 V-	Optimize	ed VC=Agf1 Ou	itlet Pressure=612.99	914 psia RMS=179,	238
Ontimized VC-HBR Out		Initial V	C=CA Outlet Pr	essure=286.3628 p	sia RIVIS=429, 150		Optimize	ed VC=CA Outle	et Pressure=540.336	1 psia RIVIS=233, 13	:0
Initial VC=LEDA2P14 Out		Initial V	/C=Gomez1 Out	essure=346.1666 p let Pressure=789 9/	457 nsia RMS=81.8	871	Optimize	ad VC=Gomez1	Outlet Pressure=81	5 1086 nsia RMS=5	35 38.626
Ontimized VC=LEDA2P1	J	Initial \	/C=Gomez2 Out	let Pressure=789.94	457 psia RMS=81.8	371 J	Optimize	ed VC=Gomez1	Outlet Pressure=81	5.1086 psia RMS=5	8.626
Initial VC=LEDA2P2.2 Out	V	Initial V	/C=GRAYM Outl	et Pressure=1075.6	07 psia RMS=232,	723	Optimize	ed VC=GRAYM	Outlet Pressure=867	7.3844 psia RMS=80	0,566
Ontimized VC=LEDA2P2	I	Initial V	/C=GRAYO Outle	et Pressure=1075.6	19 psia RMS=232,7	732 🗸 🚽	Optimize	ed VC=GRAYO	Outlet Pressure=867	4332 psia RMS=80),595
optimized ve-cebrici cim		Initial \	/C=HBR Outlet P	ressure=1192.349	psia RMS=313,641	_	Optimize	ed VC=HBR Out	tlet Pressure=1035.8	48 psia RMS=205,7	794
Initial VC=LEDA3P1.4 OutL	V	in the second									
Initial VC=LEDA3P1.4 OutI Optimized VC=LEDA3P1	v	Initial V	/C=LEDA2P1.4 C	utlet Pressure=824	1.0466 psia RMS=7	4,599 🖌 🗕	Optimize	ed VC=LEDA2P	1.4 Outlet Pressure=	816.6272 psia RMS	=54,88
Initial VC=LEDA3P1.4 Outl Optimized VC=LEDA3P1 Initial VC=LEDA3P2.2 Outl	v v	Initial Initial	/C=LEDA2P1.4 C /C=LEDA2P2.2 C	utlet Pressure=824 utlet Pressure=837	1.0466 psia RMS=7 7.5438 psia RMS=9	4,599 🖌 —— 1,958 🖌	Optimize Survey d	ed VC=LEDA2P ata BDSN2 21/	1.4 Outlet Pressure= 06/2023 00:00:45	816.6272 psia RMS	=54,88
 Initial VC=LEDA3P1.4 Outl Optimized VC=LEDA3P1 Initial VC=LEDA3P2.2 Outl Optimized VC=LEDA3P2 	V V	Initial \	/C=LEDA2P1.4 C /C=LEDA2P2.2 C	utlet Pressure=824 utlet Pressure=837	1.0466 psia RMS=7 7.5438 psia RMS=9	4,599 🖌 1,958 🖌	Optimize Survey d	ed VC=LEDA2P ata BDSN2 21/	1.4 Outlet Pressure= 06/2023 00:00:45	816.6272 psia RMS	=54,88
Initial VC=LEDA3P1.4 Outl Optimized VC=LEDA3P1 Initial VC=LEDA3P2.2 Outl Optimized VC=LEDA3P2 Initial VC=MB Outlet Pres	¥ •	Initial Initial	/C=LEDA2P1.4 C /C=LEDA2P2.2 C	utlet Pressure=824 utlet Pressure=837	.0466 psia RMS=7 .5438 psia RMS=9	4,599 v 1,958 v	Optimize Survey d	ed VC=LEDA2P ata BDSN2 21/	1.4 Outlet Pressure= 06/2023 00:00:45	816.6272 psia RMS	=54,88
Initial VC=LEDA3P1.4 Outl Optimized VC=LEDA3P1 Initial VC=LEDA3P2.2 Outl Optimized VC=LEDA3P2 Initial VC=MB Outlet Pres	 ✓ ✓ ✓ 	Initial \	/C=LEDA2P1.4 C /C=LEDA2P2.2 C	utlet Pressure=824 lutlet Pressure=837	.0466 psia RMS=7 .5438 psia RMS=9	4,599 🖌 1,958 🖌	Optimize Survey d	ed VC=LEDA2P ata BDSN2 21/	1.4 Outlet Pressure= 06/2023 00:00:45	816.6272 psia RMS	=54,88
Initial VC=LEDA3P1.4 Outl Optimized VC=LEDA3P1 Initial VC=LEDA3P2.2 Outl Optimized VC=LEDA3P2 Initial VC=MB Outlet Pres	¥ 4	Initial \	/C=LEDA2P1.4 C /C=LEDA2P2.2 C	utlet Pressure=824 utlet Pressure=837	.0466 psia RMS=7 .5438 psia RMS=9	4,599 √ 1,958 √	Optimiz Survey d	ed VC=LEDA2P ata BDSN2 21/	1.4 Outlet Pressure= 06/2023 00:00:45	816.6272 psia RMS	=54,88
Initial VC=LEDA3P1.4 Outl Optimized VC=LEDA3P1 Initial VC=LEDA3P2.2 Outl Optimized VC=LEDA3P2 Initial VC=MB Outlet Pres v	4 4	Initial \	/C=LEDA2P1.4 C /C=LEDA2P2.2 C	utlet Pressure=824 utlet Pressure=837	.0466 psia RMS=7 .5438 psia RMS=9	4,599 v 1,958 v	Optimiz Survey d	ed VC=LEDA2P ata BDSN2 21/	1.4 Outlet Pressure= 06/2023 00:00:45	816.6272 psia RMS	=54,88
Initial VC=LEDA3P1.4 Outl Optimized VC=LEDA3P1 Initial VC=LEDA3P2.2 Outl Optimized VC=LEDA3P2 Initial VC=MB Outlet Pres Initial VC=MB Outlet Pres et BDSN-2 - Data matching	¥ 4	Initial V	/C=LEDA2P1.4 C	utlet Pressure=824 utlet Pressure=837	.0466 psia RMS=7 '.5438 psia RMS=9	4,599 d 1,958 d	Optimiz Survey d	ed VC=LEDA2P [.] ata BDSN2 21/	1.4 Outlet Pressure= 06/2023 00:00:45	816.6272 psia RMS	=54,88
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Figure IV.33: Data Matching of BDSN-2



Figure IV.34: Data Matching of BRD-15

IV.2.6 Simulation Results

The results presented here in summarize the outcomes of PIPESIM simulations conducted for the project, specifically focusing on the performance of the employed Booster and the resulting flowrates and pressure characteristics for the designated candidate wells.

				ST			ST
		Temperature	ST oil	Water	ST gas	ST gas	Water
Name	Pressure(out)	°C	rate	rate	rate	GOR	CUT
	Psig		SM3/d	SM3/d	SM3/d	SM3/SM3	%
BDSN-1	112,8601	87,58207	42,23273	0	96777,74	2291,534	0
BDSN-2	96,52816	84,53686	17,05269	0	44112,52	2586,836	0
BRD12	86,96652	86,40932	4,432331	0	13720,32	3095,51	0
BRD-15	102,7197	80,83314	18,81405	0	58239,08	3095,51	0
BRDS-1	171,2682	122,4592	118,7227	0	164483,9	1385,446	0
BRDS-2	94,45031	103,2312	26,27636	0	36404,49	1385,446	0
BRDS-EXT2	124,8975	118,0181	73,46516	0	156702,5	2133,018	0

Table IV.6: Results of PIPESIM simulation.

To evaluate the effectiveness of our proposed methodology (Boosting Method), we conducted a comparative analysis of the simulation results obtained from PIPESIM with the actual data from previous well tests. The comparison is presented in the form of graphs, allowing for a clear visualization of the performance and accuracy of our approach.



Figure IV.35: Well-test data VS PIPESIME simulation results of Whp.



Figure IV.36: Well-test data VS PIPESIME simulation results of Qg.



Figure IV.37: Well-test data VS PIPESIME simulation results of Qcond.

The simulation results validate the Booster suitability for the project and confirm its ability to deliver the required flow rates to the candidate wells. The flow and pressure analysis provides a comprehensive understanding of the fluid dynamics within the pipeline network, ensuring safe and efficient operation.

IV.3 The Economic Study

It is essential to conduct an economic evaluation of any operation to justify its implementation on wells. This involves calculating the total cost of this particular operation on the one hand, and on the other hand, calculating the possible daily gain of the production expected from the wells. This will enable us to determine the amount of time necessary to recover our investment and begin generating profits from the project.

IV.3.1 Estimation of the costs associated with the booster unit

In order to calculate the total costs associated with installing the Booster unit, it is necessary to know:

- > The daily rental price of the Booster unit: is 13000 to 14000 USD \$
- The duration for which the unit needs to be installed (NPT): it takes approximately 20 days to set up and install the boosting unit which during the wells well not produce.

NB:

- The booster daily rental cost includes the setup cost of the booster unit and all its related expenses (labour, equipment, etc.).
- We chose the maximum cost possible of the booster (which amounts to 14000 USD\$), to represent the daily rental expenses of the booster in our study. In order to account for the highest potential financial losses in this project.

IV.3.2 The expected average daily production and income

Based on our simulation using the PIPESIM software we were able to estimate the expected average daily production rate of our candidate wells after using a boosting unit, as highlighted in the table below. This data allows us to estimate the probable daily income of this project:

Table	IV.7:	Expected	average	daily	production	for rate natural	gas,	condensate and	GPL.
-------	-------	----------	---------	-------	------------	------------------	------	----------------	------

Pro	ducts	Natural Gaz	Condensate	GPL	Total daily
Daily rates		mmBtu	TM	TM	incomo
		21307,6247	102,761982	53,0936907	income
Daily	USD\$	271106,4972	54533,2148	21502,94473	347 142,66
income DZD		36431291,1	7328173,405	2889565,713	46 649 030,22

NB:

The data in our calculations is based on the average base price of natural gas, condensate and GPL in May 2024.

Table IV.8: The base price of natural	l gas, condensate and GPL in May 20)24
---------------------------------------	-------------------------------------	-----

Products	Natural Gaz	Condensate	GPL
Unit	USD \$/mmBtu	USD \$/TM	USD \$/TM
Base price	12,72345	530,675	405

1Sm3 =0.04 mmBtu

1USD= 134,38 DZD (As of 25/05/2024)

IV.3.3 The Net Gain of the Boosting Project

The total net gain of the project is equal to the expected production rate in a day minus the daily rental cost of the booster multiplied by the number of operating days minus the total lost during the installation period. We can formulate it as such in equation IV.1:

Total net gain =	(Total daily production income -	daily rental for boosting unit	× Number of operating days	Total lost costs during the installation of the booster	(IV.1)
Whomas					

Where:

```
Total lost costs
during the installation = NPT \times \left( \begin{array}{c} Daily \\ rental cost \end{array} \right) + \begin{array}{c} Total daily \\ production income \end{array} \right) = 7222853,2 USD$ (IV.2)
```

As we can see all the elements in formula **IV.1** are known aside from the number of operating days, which we need to determine in order to estimate the point at which we will cover our investment and begin to make a profit from this project. Our goal is to reach where the total production income is higher than boosting unit expenses.



Figure IV.38: Boosting unit expenses vs. total production income curve.

Even though we still have a system rental cost, the daily profitability will eventually cover it. As it is shown in Figure IV.38 the investment will be paid off relatively quickly. According to our calculations, after approximately 22 days of production, we begin to make a profit. Therefore, it's clear that the booster project has the potential to be profitable long term.



Conclusion

While a definitive assessment of the booster unit's efficiency for the seven candidate wells (BRDS-1, BRDS-2, BDSN-1, BDSN-2, BRD-12, BRD-15, BRDS-Ext2) requires further analysis, the technology presents a compelling case for boosting production rates.

Our research demonstrates a significant increase in gas and, particularly, condensate flow rates. Notably, the use of a booster unit eliminates the wells' distance as a production obstacle. We were able to achieved an average flow rate of 568474.9 Sm3/day, demonstrating the booster's effectiveness.

Furthermore, our economic evaluation indicates a remarkably short payback period. Within approximately 21 days, following this period, production profits will significantly exceed the initial investment.

This translates to a highly cost-effective solution that overcomes distance limitations and boosts overall production efficiency.

Additionally, the unit optimizes flow conditions, minimizing energy consumption and potentially extending the reservoir's productive life. This translates to long-term cost savings and a sustained revenue stream.

However, the most significant economic benefit likely arises during a critical period of reservoir pressure decline. Here, the booster unit acts as a countermeasure, preventing production decline and ensuring economically viable well performance – a crucial factor for maintaining profitability.

Ultimately, a cost-effectiveness analysis alongside a detailed reservoir engineering study will determine the optimal timing for implementing the booster unit. However, our research results strongly suggest that this technology can be an effective method that maximize production efficiency, extends wells life, and ultimately boosts their bottom line.

Recommendations

To ensure a more accurate study and realisation of this project, we would like to add some suggestions:

- We propose using Machine Learning to provide better evaluations of the results obtained based on the modeling of PIPESIM and MBAL Software.
- We suggest the possibility of creating a new LP manifold that connects the candidates wells to the LP inlet of the processing facility (CPF).
- For the well BRD-1, we recommend using another boosting unit to increase its pressure.
- Another potential solution for BRD-1 is to create a new pipeline that connects it to the HP BRD-MF01 to boost it with the other wells.
- Boosting methods offer a temporary solution to the current reservoir pressure decline. Therefore, it's crucial to consider and potentially use other production optimization methods that often involve direct intervention at the reservoir level.

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	D	ESIGN	ATION			TY	PE & DIMI	MENSION					
P/Base	e FMC ca	sing he	ad hous	ting 20)" 3K x	: 13"5/8	3 CHH 5K						
Tubin	g Head C	ameroi	n	13	"5/8 x	11"-5K	(
Adapt	er Came	ron		1	"-5K x	c 4"1/16	5-5K			18"5/8			└── 71 m
ARBR	E NOEL			4'	1/16-5	K				J55 87,5#		CL	5%
VANN	E HYDF	RAULIC	LIQUE 2 Vannes 4"1/16-5K: 2VM										
				EQUIPEME	<u>FS DE</u>	FON	D	1.0110					
N	The Level	1103	DESIGNATION						TOP	13"3/8			437 m
1	filetée 4"	1/2NV	NOM. H AM (F)х-	4"1/2 N-Vam (F)	Bore, 15.10#	BTM	=0.67 (olive	0,481	0,000	N80 68#			
2	Réd 4"1/	2NVam	MxVan	Top M 13.50#1	3%cr N	480,ID	=3.920	1,228	0,481				
3	01 Tbg 4	"1/2 var	n top 13	.50 # 13% cr VM	80			26,617	1,709				
5	Pup joint	4"1/2 va	m top 13.	.50 # 13% cr VM8	0			0,888	28,326				
6	Pup joint	t 4"1/2 v	am top l	13.50 # 13% cr V	M80			0,894	29,214				
7	Flow cou	pling 13	3% Cr C	95 -4"500- 13.50) # VA	M TOP	FXM	1,796	30,108				
8	TRSSV / 3"688	4″1/2 V	am Top	13.50# -7500 ps	i avec s	siège in	ıtégré	1,366	31,904				
9	Flow cou	pling 13	3% Cr C	95 -4"500- 13.50	# VA	м тор	FXM	1,757	33,270				
10	202 Tubi	ng 4"1/	2 vam to	p 13.50 # 13% cr	-N80-	ID=3"9	920	2554.626	35,027				
11	Pup joint	4"1/2 v	am top 1	3.50 # -13% cr-	VM 80)		1,423	2589,653	3			
12	Siége R :	3"688 1	L Nipp	le 4"1/2 - 13.50#	VAMT	FOP F2	хм	0,378	2591,076	5			
13	Pup joint	4"1/2 v	am top 1	3.50 # 13% cr V	M 80			1,476	2591,454	4			
14	1 tbg 4"1	/2 vam	top 13.5	0 # 13% cr N 80				12,645	2592,930	0			
15	Pup joint	t 4"1/2 y	am top 1	13.50 # 13% cr V	M 80			1,420	2605,575	5			
16	Ratch lat	ch 4"1/2	2 OD -13	50# VAM TOP	model	seals 13	3% cr	0,593	2606,995	5			
17	Packer M	MHR 7'	'23-32#	max, OD 5"875	ID 3.8	875 80M	(1,815	2607,588	3			
18	L=1.02N Millout e	t) Das I	5"18#	NVAM M v M	KCI U.G	BUIN		1.665	2609.403	3			
10	Pád 5" 1	8# N V	1 J 10#	1/2" VAM TOP I	3 50#	E v M		0.305	2611.069				
20	Flow Cn	4 5" Va	m Top 1	B P 15 10 #13Cr	5.50#	1		1 795	2611,373	<u>{</u>			
20	Siége typ	pe RN 4	4" 1/2 N	VAM 13.5 # 13	% Cr	ID= 3.0	688 NO	0,426	2613,168	T/LNR 7"			2211 m
22	GO 3.45	6 F x N	1 /2 VAN	(TOD 12 6# 120	(C. V	1 20		2.020	2612 50/	9"5/8 P110_53.5#		_ I	_2416 m
22	Tube per	tore 4 1	12 VAN	1 TOP 15.5# 15	OUT V	M 80	D. 4#	3,020	2015,594				
23	Mule Sho	be Guid	e 4 .90 \	PERFOR	ATIC	NS	D:4	0,505	2010,014	HX]	ł		
D/	TE	DHASI	TID	TVPF	1	DEN	FUD	TOP	DTM	<u> <u> </u></u>	E		
27/03	7/2012	60°	6SPF	2"7/8 Power Jet C	mega	36"	0.34"	3327	3331				
				CAS	INC			3354	3357	T/LNR 4"1/2			2660 m
Hal	a Cirra		511	120			2*174	891/2	2010	-			
Casir	1g Size	18"	5/8	13"3/8			2 1/4 9"5/8	7"	4"1/2				
Casir	ng Con	BI	IC	BTC		N	VAM	N VAM	N VAM	7" P110 32#			2244 m
OBSE	RVATIO	ONS :											5244 m
Puits fo	oré par El	NAFOR	06 : Ha	ut TR- = 7.68 M									3327 m
Début	de forage	le : 24/0	04/2012,	Fin de forage le	21/06	/2012				TAGS			
Puits s	sous saumure densité 1.30												3357 m
Espace	ace annulaire 18"5/8 x 13"3/8 cimenté au jour									T/CMT			2407 m
Espace	space annulaire 13"3/8 x 9"5/8 sous boue à l'huile d: 1.05 space annulaire 9"5/8 x 4"1/2 sous saumure d: 1.30									4"1/2 P110_13.5#		1	3410 m
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										X= 309 735 91		
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BKDS-1		D	FSFDV	OID SI	LUDIEN	B 2		COL	IPE TECHNIQUE	Zsol = 209 m		
		К	ESERV	UIK SI	LUNIEN	D 2		cot	TE TECHNIQUE	Ztab = 219.95 m		
		EQU	JIPEMEN	NT DE SU	URFACE							
D PLAQUE DE B/	ESIGNA'	FION		20"3/4-3K	TYPE & D	DIMENSIO	NS		1			
CASING HEAD				20"3/4-3K	x 13*5/8-5K				1			
DSA CASING SPOOL	L			13"5/8-5K 13"5/8-10	x 13"5/8-10K				4 📗			
PACK OFF FL	ANGE			11"5/8-151	K x 11" 10K				1 🔳			
TUBING HEAD				11" x 7"1/ 7"1/16 10	16 10K- FMC	- FMC			4 📗	18"5/8		
ARBRE DE NO	EL			4*1/16-101	K - FMC	- The			1 📗	L@518 m		
VANNES HYDR	AULIQU	IES		4"1/16_10	K (VMS+VL)	- FMC			-			
210		EC	UIPEMI	ENTS DE	FOND	LONG	TO	D				
N ^o	hanger 4	5" 12 5	VAM EM	IC IC		0.457	0.00	P 0				
2 Pup Joi	nt X/Ove	r 4.5" N	VAM-V T	OP		1,285	0,00	57	1 🛽			
3 326 Tu	bing Jt 4.	5" 13.50	# 13Cr L1	3 V TOP		3868,767	1,74	12	1 🛛			
4 Hallibu	rton 3.6	88" R n	ipple 4.5"	15.10# V/	АМ ТОР	0,376	3870,5	509	1 🛽			
5 Tubing	Jt 4.5" 13	3,50 # 13	3Cr L13 V	TOP		11,849	3870,8	885]	13"3/8 P110		
6 Pup Joi	nt 4.5" 13	3,50 # 13	3Cr V TOI	2		2,019	3882,1	734	↓ ~ ■	@2816 m		
7 Ratch L	atch					0,527	3884,1	753	- ∎	(action)		
8 7" MH	R Packe	r				1,943	3885,2	280				
9 Mill Ou	it Extensi	ion				0.305	3887,	,22		0000 0110		
10 Red.ada	upling 4	5" Vam	Top B P	13Cr		1,755	3000,	12		9"5/8 P110 BTC 53.5#		
12 Hallibr	rton 3.6	88" RN	ninnle 15	10# (NO (30 3 456	0.425	3890	.87		@3548 m		
13 Perfora	ted Pup J	oint 4.5'	15.10 #	108 (110 1	30 5,450)	2,979	3891.	.30				
14 Mule S	hoe Guid	e				0,215	3894,	,28	<(>>) 📕			
15 Fin con	plétion						3894,	,49	1 🕺 📘			
			PERFO	DRATIO	NS	-			i ∢ŵ≻∎∎			
DATE	DIAM	DENS	TYPE	PENETR	TOP	BTM	RESERV	VOIR		1		
03/04/2010					3934,0	3936,0			1 2 13 3			
02/04/2010	4"5/8	5	SDP JRC	43"	3940,0	3946,0	Silurien	1 "B2				
02/04/2010					3959,0	3963,0	Somm	ict		2 () () () () () () () () () (
23/03/2010	4"1/2	5	SDP JRC	43"	3996,0	4005,0	Silurien	1 "B2	-	C:1 11D-31		
					4070.0	4073.0	Uase			upper		
					4076,0	4081,0	-			Sil"B2"		
08/03/2010					4096,0	4100,0	Silurien	"B1"		Lower		
					4108,0	4112,0	1			BP Nº4@ 4040 m		
16/02/2010					4190,0	4198,0				BP N'3@ 4048 m		
15/02/2010					4202,0	4205,5	Silurien	"A2"				
15/02/2010					4209,0	4213,0	1			Perfos(Sil B1)		
OBSERVATI Completion faite Début forage: 01 Quartzite de Han Work Over "EN B2. String comp Rig Elevation à 7	ONS: par Rig E /05/2009, nra "QH") NF 34" (D ression 7T F.D Bolts	ENF-16 , Fin de s 0 0 07/02 a 2 -0,810 n = 6,650 n	ondage: 14/ au 22/03/20 m, Tubing st n.	04/2010,TI 18) : Comp tretch : 3,52	O sondeur : 55: létion du puits 20 m ;	34m (Nivea dans le rés	u atteint : ervoir Silt	urien	Cement Plug N°2 4180-4125 m Tête liner 4804 m S302-5178 m Quartzites de Hamra	4112m BP N°2@ 4180 m Perfos (SiLA2) 4190 m 4213 m 7" P110 32# NV@ 5004 m BP N°1@ 5313 m 4"1/2 P110 13,5#@ 5533		
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		FIC	CHE TECHI	NIQUE			COORDO	NEES UTM	X= 309 195.86 m Y= 3 377 926.46 m				
BRDS-2		Réservoir Silurien F6-B2							COUPE TECHNIQUE H table = 8,15m				
		EQUIPEMENTS I	DE SURFACE										
Désignation	Fabricant	Type/modèle/PN	Dimension nomi	inale Sé	rie	Observation							
Casing Head Housing			20"3/4 20"2/4 × 12"5/8	3K	5V								
Casing Spool	+		20°5/4 x 15°5/8 13"5/8 x 11"	5K x	10K		@57m		Sabot 30"				
Pack-off Flange Adapter			11"	10K	C5K								
Tubing Head	FMC		11" x 7"1/16	5K									
Adaptateur	FMC		7*1/16 x 4*1/16	5K			470m		- SBT 18"5/8				
Suspension		Olive	7*1/16	5K									
Vanne maitresse inférieure	FMC		4"1/16	5K		Manuelle							
Vanne maîtresse supérieure	FMC		4*1/16	5K		Hydraulique							
Croix Vannas latérala (aŝte nuedu	Cameron		4-1/16	5K		Undernligue							
Vannes latérale (côte kill)	Comoron		4 1/16	5K		Manuelle							
Vanne de curage	Cameron		4"1/16	5K		Manuelle	1						
Top Cap	FMC		4*1/16	5K			1						
Top cap	r me		1				1						
		EQUIPEMETS	DE FOND						SBT 13"3/8				
N	D	ESIGNATION			LONG	TOP	2572 m						
1 OBvo 7"1/16 NOM 4"	1/2N Vam da	ESIGNATION	UD E-DDV MIN D	ODE 3"000	0.445	0.00	t						
2 351 Tubing 4.5" 13.5#	SM85 N.VAM	WIIF X4 1/2 LTC	UP F; DF V MIN D	OKE 5 900	3566.57	0,445	1						
3 Nipple R 3.688"					0,355	3567.02							
4 01 Tubing 4.5" 13.5# S	M85 N,VAM				10,206	3567,371	3380 m J		SBT 9"5/8				
5 01PUPS JOINT 4.5" 13	.5#13Cr				1,469	3577,577	1						
6 Ratch Latch					0,590	3579,046	1						
7 7" MHR Packer					1,817	3579,636							
8 Mill Out Extension					1,590	3581,453	<u></u> <u></u> <u></u> <u></u> <u></u> <u></u> − <u></u> <u></u> <u></u> <u></u> − <u></u> <u></u> <u></u> <u></u> <u></u> − <u></u> <u></u> <u></u> <u></u> <u></u> − <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> − <u></u>						
9 Red.adapter	<u></u>	1											
10 Plow Cp 4.5 Van Top	CO 4"1/2 13	50# V TOP			1,795	3585,347	່ ໂໍ່∠ໄ∎						
12 Perforated Pup It 4 5" 1	3 50# 13CR V	AM TOP P8 30			2.947	3585 566	<u></u>						
13 Mule Shoe Guide 4.5"	13 50# VAM T	OP			0.303	3588 513		- 🎬 🔤 🕞	~				
14 End of completion					0,000	3588,816	t	۲ 🛃	<u>ل</u>				
		PERFORAT	TIONS				3600 m	П	Top liner 4" 1/2				
DATE DIAM	DENS	TYPE	PENETRATION	TOP	BTM	REMARQUE							
- 0,33"	6spf	Gun 2"7/8	41,2"	3758 m	3767 m	TAGI Perfos	3707 m	L	SBT 7"				
				2802 6	2807	squeezees	+ I						
0.33"	6snf	Gun 2"7/8	41.2"	3812.5 m	3815	Silurien F6-B2							
0.00				3827.5 m	3832 m	Perfos ouvertes							
OBSERVATIONS : Debut de Forage : 11/04/2015 , F Debut de completion 06/10/2015 Puits producteur du Gaz et Cond	in de Forage : 1' , Fin de comple ensat	//10/2015 tion 17/10/2015					3767 m 3802,5 m 3832 m 3996m - BC 4000 - 4543 TD 4544m	si	Perfos Squeezées Perfos Ouvertes BT/L 4° 1/2				
							Mise à jour l	e 11/10/2019 pr	ar service tech-puits				

<u> </u>										37 200 202 52
				CH		FCHN	JIOUF	•	COORDONNEES UT	'M X= 309 392,52 m
DD	CN 1		I , I				UQUE	4	COORDONALES CT	Y= 3 400 212,78 m
BD	DIN-I						~~			Zsol = 195 m
				R	ESEI	RVOIR TA	IGS		COUPE TECHNIQU	$E_{\text{Ztab}} = 205.82 \text{ m}$
		<u> </u>	FOLU	DEME	NT DI	SUDEACE				200,02 m
	DESI	CNATU	ON			TVPF & D	IMENSIONS			
TURIN	G HEAD	JIAII			13"5/8	5K x 11" 5K - C	rown		• • • • •	
ADAP	TATEUR				11" 5K	x 4"1/16 5K- F	MC		1 📂	
Vannes	hydrauli	ques			LMS +	UHMV 4 1/16	' 5K - FMC		1 🔳	
X mas '	Tree				4"1/16:	5K - FMC]	
Wing v	alve				4"1/16:	5K - Hydraulic l	FMC			
Swab v	alve				4"1/16:	5K - FMC				
Top ca	p				4 1/10	SK - CROWN				
			EQU	IPEM	ENTS	DE FOND			18"5/8	59 m
N			DES	IGNAT	ION		LONG	ТОР	K55-87.5#	
1	Olive Cro	wn 11"	taraudé	e 4"1/2	NV B x	4"3/4 ACME	0,485	0,00	1	
2	Pup Join	t					1,060	0,49	1 📕	
3	310 join	ts de tu	bing 4.	5" New	Vam P	2110 13.5#	2905,425	1.55	1 📕	
4	OTISL	Ninnl	e R 4"	1/2. Nev	v Vam	,	0.350	2906.97		107
5	Dup It 4	5"	CICT .		· · am		2,060	2907.32	13"3/8 N80.68#	_49/m
	Laint Tai	J hina 14	511				0.280	2000.28	100 000	
0	Joint Tu	bing 4		(0.3.5			9,280	2909,58		
7	Baker A	nchol S	eal 4"1	/2 New	/ Vam		0,900	2918,66		
8	Baker H	lydrau	lic Pac	ker SA	BL3 7'	' 32-38#	1,740	2919,56	T/I NR 7"	
10	Reducin	g adapt	er 4"1/.	2 NV x	5" VA	М	0,210	2921,30		2595 m
9	Mill Out	Extens	sion 5"	VAM			1,700	2921,51	1	2680 m
11	Flow co	ipling 4	4"1/2 N	V			1.800	2923.21	1 - 1	C 2009 III
12	OTISL	Ninnl	e RN 4	"1/2 N	ew Var	n	0 390	2925.01	9"5/8	
14	Mula Gu	ide Sh		/ Now	Vom		0,590	2025.40	P110 53.5#	
14	Mule Ou	nue She		2 INCW	vam		0,000	2925,40		
15	End of c	ompleti	ion					2926,00		
OBSE	RVATI	ONS								
Comp	letion réa	lisée p	ar l'ap	pareil	ГР-139)				
Г	Date	Diam	Dens	Туре	Pénét	Top (m)	Bottom (m)	Réservoir		
⊢						3732.5	3747.5	TAGS		
						3132,5	5141,5	TAUS		
									T/I NP 4"1/2	2935 m
									1/LNK 4"1/2	
									7" 0110 20#	2612
									/" P110 52#	3015 m
1									◀	•
									4"1/2 P110.12.5#	TD: 3799 m
									Mise à jour le 15/10/2010	9 nar Sce Truite
									wrise a jour le 15/10/2019	par see rpuits

	DD	10	FICHE TECHNI					E		COORDO	NEES UT	M	X-311 175,000 Y-3 382 500,000		
B	RD	12		RI	ESERV	OIR T	AGS			COUPE TI	ECHNIO	UE	Zsol =	190 m	
⊢										1			Ztab- 1	97,9 m	
		PROLON	EQ	UIPEMENT	DE SU	RFAC	E				1				
COM	PACT C	SG HO	USING I	R-TOOL	13"5/8-5	K (BX	160), WP:	6500 psi		1	"		r		
ADAP	PTER A	VEC VA	NNE		13"5/8 -5	5K x 4"	1/16-5K			18"5/8		H	i		
SUSP	ENSION				OLIVE 1	3"3/8 N	NOM BPV	3"980		K55	1			_65 m	
VANN	CE NOE	RAULI	OUE CA	MERON	4"1/16-5 2 Vannes	4*1/16	6-5K: 2VM	+VL		< <u>66</u>					
			20000	OUIPEMET	S DE E	OND				Ť	(
N				DESIGNATIO	N	0		LONG	тор	-					
1	SSMC	13"5/8 C	am Tbg I	Hanger, 4"1/2 V	am top F	with 4	" BPV,	0.500	0.00	1					
	type H	& 1/4" C	L port, I	D: 3*870	2020.5	0,500	0,00	-							
1	01 the 4	1/2" Vam	5# 13%C	# 15% Cr-L80 Cr-L80 Vam tor	OD: 4"90	3"795	1,460	1.96	13"3/8				435 m		
2	P/ J 4*1	1/2' Vam	Top 13,5	5# 13% Cr-L80	OD: 4"9	3"795	1,510	14,21	N80 68#						
3	01 tbg 4	1/2" 13,	,5# 13%0	Cr-L80 Vam top	o, OD: 4"	'968, ID): 3 * 795	12,020	15,72	1					
4	P/J4*1	1/2' Vam	Top 13,5	5# 13% Cr-L80	OD: 4"9	68, ID:	3"795	1,510	27,74	4					
5	TPSSV	g 4 1/2" Hall 3 (13,5# 13: \$88" NE	Self Foundizin	a OD: 5,1	970 75	: 3,795 500 PST	1,760	29,25	-					
6	13,50#	13%Cr	-30 NE.	Sen Equanzin	s OD: 0,	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		1,370	31,01		1				
7	F/ Cplin	ng 4 1/2"	13,5#13	%Cr- C95 V to	p, OD: 5	,128, II	D: 3,795	1,750	32,38]					
8	P/J4"1	/2' Vam	Top 13,5	# 13% Cr-L80	OD: 4"96	68, ID:	3*795	1,590	34,13						
10	P/J 4"1	/2' Vam	Top 13,5	# 13% Cr-L80	OD: 4"9	68, ID:	3*795	1,400	2510,72	1					
11	Siege 4"1/2 Vam Top 13,50# type R 3,688"Hallib, OD: 4"982,): 4"982,	0.380	2512.12							
12	12K ps	i wp /2' Vam	Top 13.5	# 13% Cr. I 80	OD: 4"9/	68 ID:	3*705	1.580	2512.50	-					
13	P/ J 4*1/2* Vam Top 13,5#13% Cr-L80 OD: 4*968, ID: 3*795						3*795	1,580	2512,30						
14	Ratch latch Nitrile seal Assembly 4"1/2 Vam Top Hallib							0.500	2515 58	1					
14	* OD:5"290, ID: 3"867- 13,50# 13%Cr 7500 psi wp						0,590	2515,56	4						
15	Hallibur 7"23-32# MHR Packer assy HNBR OD:5"875, 15 ID: 3"875, 7500 noi way Nitrily Electorycer 138/ Cr EW						75,	1,810	2516,17						
	Millout	Extensio	n 5" 18#	New Vam Mx	M 13% C	Tr 1000	0 Psi	0.000	2512.00	-	1				
16	wp,OD:	5"035,1	ID: 4*220)				0,990	2517,98	T/LNR 7"				2240 m	
17	Adaptor	5*18#1	N-Vam F	x 4"1/2 Vam To	op M 13,	,50# , 1	3% Cr	0,310	2518,97		Π				
19	8540 ps	1 wp , O	D: 5"610, Top 12.5	, ID: 5,884 # 12% C+ I 80/	00-420	69 ID.	2*705	1.500	2510.28	9"5/8 P110_47#	- -		L 14	2394 m	
19	02 tbg 4	1/2" 13	.5# 13%C	r-L80 Vam tor	DD: 4 9	968, ID:	3 795): 3"795	24,390	2520.87	 					
20	P/J4"1	/2" Vam	Top 13,5	# 13% Cr-L80	OD: 4"96	68, ID:	3*795	1,500	2545,26	Ĩ					
21	Siege 4	"1/2 Vai	n Top 13	8,50# type R 3,	688"Hal	llib,		0,380	2546,76	5 15 2					
22	OD: 5" P/J4"1	003,120 /2' Vam	00 psi wj Top 13.5), 13% Cr # 13% Cr-L80	OD: 4"9	68. ID:	3*795	1.590	2547.14	·					
23	01 tbg 4	1/2" 13	5# 13%0	Cr-L80 Vam top	, OD: 4"	968, ID): 3*795	11,980	2548,73	1					
24	P/J Perf	oré 4"1/2	2 Vam To	op 13,5# 13% C	r-L80 O	D: 4"96	58,	3.020	2560,71	1					
	ID:3"79	5	E 120/	0.12.00%.07		10.00	10	0,020	2000,00	5 21 5					
25	Sbt 4 1/	2" Vam	Top 13%	Cr 13,50# , OL	J: 4,960,	ID: 3,8	67	0,300	2563,73	~					
		DILLE		PERFOR	ATION	5		TOP	Dist	4					
D	ATE	PHASI	TIR	TYPE 201/2 SULA	I	PEN	EHD	3311	3312	-				2574	
11/0	2/2012	60°	6SPF	CHARG	E	34,46"	0,35"	3313,5	3320	T/LNR 4"1	/2			2574 m	
OBSE	RVATI	ONS :						3324	3332	7"				3220 m	
Rig na	me : TP	200, Dél	out forage	e le 25/08/2006,	, Fin fora	ge le 07	7/02/2007,	Bouchon	de ciment	P110 32#	I				
à 3382	2 m, 1500	00 Lbs c	ompressi	on											
														3311 m	
										TAGS					
1														3332m	
1											h		Cem	ent retainer à 3382 m	
1										4*1	_{1/2}		_L ,	438 m	
										P1	10 13.5#		3	450 III	
1										Mi	se a jour le	06/05	5/2014 pa	ar See Tpuits	

				FICHE	TECH	INIQUE			COORD	ONNEES TM	X- : Y- :	314 128,965 m 3 371 490,006 m
В	RDS-Ext2			RESERVO	R SILU	RIEN F6-A2			CO	UPE	Zsol	- 212,495 m
									TECH	NIQUE	Ztab	= 222,495 m
			EQUI	PEMENTS DE SU	URFACE							
DESIG: Plaque	NATION de base	Fabricant	Modèle	Dimension nominale	Série 3K	Observa	itions					
Casing S	Spool			20"3/4 x 13"5/8	3K x 5K				1		1	
Tubing	Head	Streamflo		13"5/8 x 11"	5K x 10K							
Vanne n	naitresse Inf	FMC		4"1/16	10K	Manu	elle		1		רי	211 1
Vanne n	naitresse Sup	FMC		4"1/16	10K	Hydrau	lique		1	I 14	۲.	
Croix	ativele de meduation	FMC	-	4"1/16	10K	Unders	Laura					
Vanne I Vanne I	aterale de production atérale (Kill side)	FMC		4"1/16	10K	Manu	elle		1			
Vanne d	le curage	FMC		4"1/16	10K	Manu	elle		1			
Тор сар		FMC		4"1/16	10K							
			EQU	JIPEMENTS DE	FOND							
N			D	ESIGNATION			LONG	TOP	18"5/8			605 m
1	FMC TUBING HAN	IGER		1.05			0,530	0,000	87,5# J55			
2	2 Jts Tbg 4.5" 13.5# X-Over 12 50# 12C1	13CT NEW	VAM VI	VAM TOP Bin			20,288	0,530				
- 3	Pup joint 4 1/2" 15 1	#13Cr1.80	VAM T	OP BxP			1,780	20,818	1			
5	Flow Coupling 4 5"	15.1 #13Cr	VAM TO	P BxP			1,755	24,580	1			
6	6.97" NE 3.688" TI	RSSSV					2,280	26,335	1			
7	Flow Coupling 4.5"	15.1 #13Cr	VAM TO	OP BxP			1,759	28,615	1			
8	4 joints tubing 4.5" 1	3.5# L13 V	AM TO)			47,428	30,374	1			
9	X-OVER 13,50# 13	CR NEW V	AM Pin :	x VAM Top Box			1,870	77,802				
10	347 joints tubing 4.5	" 13.5#130	r NEW V	AM VM 85			3537,629	79,672				
11	X-OVER 13,50# 13	CR NEW V	AM Box	x VAM Top Pin			1,944	3617,301				
12	65 joints tubing 4.5"	13.5# L13	Vam Top)			766,335	3619,245				
13	Siège R 3,688"	TOP					0,379	4385,580	.			
19	4.5 15.5# L15 VAN	110F	TOP how				1 982	4303,939	1			
15	Ratch Latch	ISCI VAM	101 004				0.528	4399 525	1			
17	7" MHR Packer						1.943	4400.053	1			
18	Mill Out Extension						1 505	4401 996	1			
19	Adaptor Crossover 4	.5" 15.1# N	V B x V	ТР			0.305	4403,591	1			
20	Flow Coupling 4.5"	15.1 #13Cr	VAM TO	OP BXP			1,755	4403,896	1			
21	3.688" RN Nipple 3	.456" No-s	0				0,425	4405,651	1			
22	4.5" 15.1#13Cr Perfe	orated PJ V	am T Bxl	p			2,976	4406,076	13"3/8		- ·	2986 m
23	Mule shoe						0,214	4409,052	68# N80			
24	Fin de complétion							4409,266				
											L 1	Top liner7"
OBSE	RVATIONS											5100 1
Début	de forage: 12/11/20	15; fin de	forage: 1	0/04/2016 (Appar	eil ENF-32)			9"5/8 -	J		L 3725 m
Début o	le complétion: 25/12/	2018; fin d	e complé	tion: 14/02/2019 (A	ppareil ENF	-34)			47 et 53,54 P110		ŀ.	3723 m
										┥ ┃		-
	Intervalle Perfos			Top (m)		Bottom (m)	Rés	rvoir]	1		128 - 4140,5 m
	l'ère série			4128		4140,5	Siluri	en B2		1 🚬		13
							(sque	ezées)				<u> </u>
	2ème série			4468		4477	Siluri	en A2			7	17
									1		J	
											D,	(21)
											2	
										Terel	ic a	4468 - 4477 m
									7" 32#	4562	m	4599 m
									P110	B	2	
									TD: 5060	m		
									Mise à jour	le 17/02/20	19 par	Sce Tpuits

Constituants	MW (g/mole)	% molaire du gaz brut	ρ (g/m³)
N2	28.014	4.643	-
CO2	44.01	0.238	-
C1	16.043	72.743	-
C2	30.07	6.788	-
C3	44.097	2.707	-
iC4	58.124	0.679	-
nC4	58.124	1.286	-
iC5	72.151	0.736	-
nC5	72.151	0.759	-
C6	86.178	1.563	0.664
C7	96	1.960	0.738
C8	107	1.326	0.765
C9	121	1.219	0.781
C10	134	0.954	0.792
C11	147	0.719	0.796
C12	161	0.515	0.833
C13	175	0.402	0.825
C14	190	0.274	0.836
C15	206	0.188	0.842
C16	222	0.115	0.849
C17	237	0.076	0.845
C18	251	0.050	0.848
C19	263	0.022	0.858
C20	275	0.017	0.863
C21	291	0.009	0.868
C22	305	0.007	0.873
C23+	350	0.006	0.877
Total		100.00	

'Sil B2'Reservoir

				1			Calculated Fluid NZ QH		
				PVT Si	L A2	· 			
_	Reservoir	Fluid GEA		wtZ	mol%	-	¥t%.	mol7.	
Componen	₩t %	Mole %							
N2	1,12	1,02					6 220	E 22	
CO2	8,89	5,14	Nz	0,299	0,312		6,320	5,32	
H2S	0,00	0,00	CO2	5,198	3,454	Π ₂ Ο	<0.001	<0.0	
C1	46,75	74,13	nC1	40,542	73,907		5,805	3,1	
C2	11,62	9,83	nC2	9,166	8,913	- U1	49,364	72,6	
C3	6,71	3,87	nC3	6,218	4,123	C2	13,560	10,64	
i-C4	1,75	0,77	iC4	2.458	1.237	C3	7,095	3,79	
n-C4	2,77	1,21	nC4	2,566	1,291	iC4	1,795	0,72	
i-C5	1,45	0,51	neo-C5	0.041	0.017	nC4	2,441	0,99	
n-C5	1,14	0,40	iC5	2,177	0.883	neo-C5	0,067	0,02	
C6	1,50	0,46	- 005	1026	0.416	iC5	1,238	0,40	
Mcyclo-C5	0,10	0,03		2 247	0,418	nC5	0,959	0,3	
Benzene	0,04	0,01	Banana	0.071	0,103	C6	1,531	0,4	
Cyclo-C6	0,16	0,05	C7	2,011	0,021	Benzene	0,114	0,03	
C7	1,47	0,39		2,244	0,000	C7	1,372	0,32	
Mcyclo-C6	0,31	0,08		0,333	0,106	Toluene	0,072	0,01	
Toluene	0,16	0,04		2,353	0,602	C8	1,322	0,27	
C8	1,52	0,36	Ethylbenzene	0,018	0,005	Ethylbenzene	0,006	0,0	
C2-Benzen	0,06	0,01	M- and P- Xylei	0,442	0,122	m- and p- Xyler	0,034	0,00	
mp-Xylene	0,23	0,06	O-Xylene	0,130	0,036	o-Xylene	0,024	0,00	
o-Xylene	0,06	0,01	C9	1,836	0,419	Сэ	0,995	0.18	
L9 C10	1,21	0,26	C10	2,169	0,446	C10	0,931	0.15	
	1,35	0,26	C11	1,831	0,343	C11	0,776	0.1	
C12	1,10	0,19	C12	1,524	0,262	C12	0.657	0.0	
C12	0,38	0.10	C13	1,539	0,244	C13	0.593	0.07	
ี เป	0,87	0,13	C14	1,377	0,203	C14	0,000	0.05	
C15	0,77	0,10	- C15	1,276	0,176	015	0,422	0,00	
C 10	0,70	0,03	C16	1,101	0,142	C15	0,423	0,04	
C10	0,60	0,07	C17	1,165	0,142	C10	0,345	0,03	
C10	0,04	0,06	C18	0,988	0,113	010	0,328	0,03	
C10	0,43	0,03	C19	0,770	0,084	010	0,257	0,02	
C13 C20+ Massa	9 1	1/ 99	C20+	6,895	0,557	เปล	0,182	U,U	