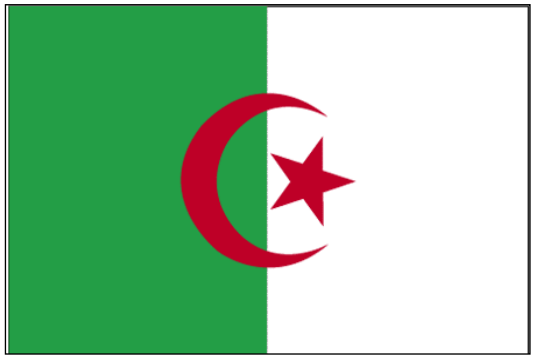
This is the Eighth Edition of our report on Algeria's Oil and Gas Industry. It contains 319 pages and includes data on 64 fields and field groups along with details on exploration activity, midstream, downstream and oil and gas infrastructure opportunities.



Algeria

Oil and Gas Industry Strategic Report

Contents, Sample Pages, List of Figures, List of Tables only

By

Bayphase
Est. 1986
Geologists, Engineers and Investment Analysts

April 2014
Ninth Edition

Our Product Clients

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Introduction

Algeria's vibrant oil and gas sector and its strategic proximity to Europe make this report a must not just for professionals interested in Algeria's oil and gas industry but also for those interested in its strategic impact on hydrocarbon supplies to the EU and the USA.

This version of our report includes full details on the latest international bidding round - the ninth. This is the third round organised by Algeria's Agence Nationale pour la Valorisation des Resources en Hydrocabures (ALNAFT) and as a result is also known as the third ALNAFT round.

This Report is the **Eighth Edition** of Bayphase's Algeria Oil and Gas Industry Strategic Report. It provides a comprehensive review of Algeria's Oil and Gas Industry, including these elements:

- **Upstream:** Fields and Production Facilities
- **Midstream:** Pipelines, Terminals
- **Downstream:** Refineries, Petrochemical Plants, Gas Processing Plants
- **Infrastructure:** Power Generation, Transportation

Though the Report presents an industry wide assessment its main focus is Algeria's upstream oil and gas fields and their production facilities. Here a basinal view of Algeria has been taken with the country catergorised in to its four main sedimentary basins:

- Trias/Ghadames(Berkine)
- Illizzi
- Grand Erg/Ahnet
- Reggane

The Report is supplied with a folded copy of the latest edition of our **Algeria Exploration and Production Two Map Set.**

The report provides analysis and enhanced data sets on **64 oil and gas fields**; some currently in production - others undeveloped awaiting investment.

From an **Oil Reserves Perspective** the report charts Algeria's probable reserves of 18.2 Billion bbls.

From a **Gas Reserves Perspective** the report charts Algeria's probable reserves of 125 Trillion Standard Cubic Feet

From an **Investment Perspective** the report shows how between 74 and 116 Billion Dollars of investment will be required by Algeria's oil and gas industry over the next 10 years to unlock its production potential.

We have developed a companion publication to this Report that analyses the economics associated with each of the fields we have identified here - see the **Algeria Fields Financial Report** web page for more details.

Report History:

- 9th Edition October 2014-319 pages
- 8th Edition April 2013-339 pages
- 7th Edition November 2011 -339 pages
- 6th Edition October 2010 - 334 pages
- 5th Edition January 2010 - 334 pages
- 4th Edition June 2009 - 326 pages
- 3rd Edition July 2008 - 316 pages
- 2nd Edition October 2005 - 326 pages
- 1st Edition November 2003 - 234 pages

What You Get:

- Paper Version of our current **Algeria Oil and Gas Industry Strategic Report**
- Free Searchable CDRom of our current **Algeria Oil and Gas Industry Strategic Report**
- Paper Version (Folded) of our current Algeria **E&P Two Map Set**

For one year following, purchasing customers will be supplied with any updates made to the report.

Field Analysis Sample

The analysis carried out on the 64 fields is indicated by the field sample provided below:

Hassi R' Mel

Hassi R'Mel (desert gate) is Algeria's first and largest wet gas field, located 550 km south of Algiers covering an area of over 3,500 km^2.

Algeria's largest gas field was the subject of a major production enhancement program. 3 gas compression centres with a total capacity of 9,850 Million standard cubic feet per day were completed in 2004. Commitment to significant further expenditure is yet to be made.

Key Field Data

The Hassi R'Mel gas-condensate reservoir is a large elliptical anticline structure with a South-West/North-East orientation. The produced gas comes from three different Triassic sand levels (A-B-C) between 7,026 feet and 7,593 feet.

- Layer A occurs throughout the field and is composed of fine sandstone with strong anhydritic cementing. Its height ranges from 43 feet – 113 feet and average porosity is 15% while permeability is 260 millidarcy. Average water saturation is 18.5%.
- Layer B is more restricted, wedging out on the southern and eastern flanks. Its composed of shaly fine sandstone intercalate in a series of shale. It ranges from 0 feet – 100 feet in thickness, porosity is 15% and average permeability drops from over 500 millidarcy in the channel axes to 0.1 millidarcy on the edges. Average water saturation here is 20.48%.

- Layer C, also restricted, is composed of fine and medium sandstone with many conglomerates. With a thickness ranging from over 0 feet in the Southern zone to 200 feet in the Northern zone this is the thickest of the three layers. It has excellent petrophysical characteristics with average porosity of 16.8% and permeability of 641 millidarcy. Average water saturation is 16.5%.

The composition of gas at Hassi R'Mel is; C_1: 78.6%, C_2: 7.3%, C_3: 2.7%, C_{7+}: 2.3%, N_2: 5.3%.

Hassi R'Mel had original reserves of some 85 Trillion standard cubic feet and the first of 5 production units were brought on production in 1974.

Key data for this field is provided in Table 211.

Table 1: Hassi R'Mel Key Field Data

Parameter			Value	
Discovery Date			1956	
Onstream Date			January 1974	
Recoverable Reserves	Original	Gas (Billion Standard Cubic Feet)	85,000	
		Condensate (Million Barrels)	3,300	
	Remaining	Gas (Billion Standard Cubic Feet)	35,000	
		Condensate (Million Barrels)	1,350	
Production	Current	Gas (Million Standard Cubic Feet Per Day)	9,850	
		Condensate (Barrels Per Day)	180,000	
	Potential	Gas (Million Standard Cubic Feet Per Day)	9,850	
		Condensate (Barrels Per Day)	210,000	
Geology	Producing Horizon(s)		Triassic (A-B-C)	
	Rock Type(s)		Sandstones	
	Reservoir Depth (feet)		7,026 – 7,593	
	Gross Rock Volume (Million Cubic Feet)			
	Reservoir Thickness (Feet)		45 - 415	
	Porosity (%)		15 – 16.8	
Fluid Properties	Oil	Gravity (^{o}API)		
		Sulphur Content (wt %)		
	Gas	Condensate Gas Ratio (Barrels/ Million Std. Cubic Feet)	39 (estimate)	
		Hydrogen Sulphide Content (mol %)		
		Carbon Dioxide Content (mol %)		
		Molecular Weight		
Existing Facilities	Subsurface	Number of Producers	Now 160	Plan -
		Number of Gas Injectors	Now 54	Plan -
	Surface	Separation Capacity (barrels per day)	200,000	
		Compression Capacity (MMscfd)	2,900	
		Acid Gas Treatment capacity (MMscfd)	-	
		Gas dehydration capacity (MMscfd)	9,850	

Hassi R'Mel has Algeria's largest gas production and processing complex. It also acts a hub for the gathering and onward export of gas from other fields across the country. This is a role that is set to expand as a number of significant gas projects are brought onstream.

Hassi R'Mel started production in 1961 with two gas processing units producing up to 45.9 billion cubic feet per year of wet gas. In 1969, another four installed units increased capacity to 141 billion cubic feet per year. From 1972 to 1974, six additional units were brought onstream raising production to 494 billion cubic feet per year, enabling the field to supply feedstock to the Skikda liquefaction plant. In 1974, 21 production wells were in operation at Hassi R'Mel.

Stimulated by the significance of the recoverable reserves of gas, condensate and LPG in the field, and the prospects for growing gas demand in Europe, Sonatrach implemented plans to further develop the fields output. However, over the period 1961 to 1979, the yield of gas liquids had decreased from 44 barrels per million standard cubic feet of dry gas (in 1961) to 40.9 barrels per million standard cubic feet of dry gas (in 1979) and it became necessary to maximize the LPG and condensate recovery by partial cycling of the dry gas.

From 1980 to 1986, while the gas liquids yield continued to drop from 40 barrels to 28 barrels per million standard cubic feet of dry gas, a major development plan was completed in October 1980, the purpose of which was to establish alternate production and reinjection zones to boost pressure in the field. The scheme involved re-injecting part of the gas produced into the reservoir at high pressure through two 1.059 trillion standard cubic feet per year compressor stations. Two lines of injectors (one line between northern and central producing areas and the other between the southern and central producing areas) were installed.

All gas production and injection modules were to operate at capacity until the plant inlet pressure of 1,422 pound per square inch (psi) limited gas production. Over the period wet gas production was boosted from 812 billion standard cubic feet per year to 3,461 billion standard cubic feet per year with additional processing facilities and an LPG recovery complex, raising Hassi R'Mel's total LPG production capacity to 28 million barrels per year, was commissioned.

Over these 15 years, more than 48.5 trillion standard cubic feet of wet gas, 1.59 billion barrels of condensates and 326 million barrels of LPG were produced from 160 wells, and 22 trillion standard cubic feet of gas was injected into the reservoir via 54 injectors.

Since 1997, Hassi R'Mel has been producing more than 3,532 billion standard cubic feet per year of wet gas at its maximum capacity. The cycling rate has decreased dramatically from 38% (in 1997) to 21% (in 1999), causing the yield of liquids per million standard cubic feet of dry gas drop from 27 barrels to 21 barrels. Liquids recovery has fallen to a level close to the minimum rate of operation required for the gas processing facilities. In addition, the pressure drop impacted the influx of the aquifer and some wells located on top of the structure in the southern part of the field, had to be shut-in due to high salinity.

The main production facilities were constructed at the field in the late seventies. 5 plants were built and all were on stream by 1979. These were of a simple design including separators and relying on Joule-Thompson plants to achieve separation of associated natural gas liquids. The names, locations and capacities of these plants are summarised in Table 212.

Table 2: Existing Plant Capacities at Hassi R'Mel

Name	Location	Capacity (MMscfd)	Type
Module 0	Central	1,900	Separation, J-T
Module I	Central	2,600	Separation, J-T
Module II	South	2,200	Separation, J-T
Module III	North	2,200	Separation, J-T

Name	Location	Capacity (MMscfd)	Type
Module IV	Central	950	Separation, J-T

Modules II, III and IV were installed by JGC.

Given the length of time of production at the field – over 20 years – Hassi R'Mel has begun to deplete and is experiencing reduced well head pressures. The constraints of the surface facilities imply a minimum pressure value of 1,636 pounds per square inch (psi) at the well head. The lower pressure in the reservoir results in lower wellhead pressure and insufficient energy to move the gas until its treatment into the different modules, necessitating gas compression to be installed.

Various simulations on the sales gas profile showed that the compression was required by 2003. Sonatrach accordingly had three major gas boosting compressor stations and 11 compression lines installed at the field in late 2003, which were designed to boost production from the well heads and to maintain design throughputs through the existing separation and treatment plants.

Compressor stations were installed at three sites:

- **North:** capacity will be 2,200 Million standard cubic feet per day and this unit will deliver gas to module III.
- **South:** capacity will be 2,200 Million standard cubic feet per day and this unit will deliver gas to module II.
- **Central:** capacity will be 5,450 Million standard cubic feet per day and this unit will deliver gas to modules 0, I and IV.

JGC implemented the installation contract for this project. The contract was awarded in May 2001.

The second phase in compression installations was completed in 2007, adding another six compression lines to the enhanced recovery system. This will maintain pressure at a level allowing maximum recovery of condensates and LPG and will extend Hassi R'Mel production life to 2020, keeping its maximum capacity of 3,532 billion standard cubic feet per year.

With regards to the marketing of Hassi R'Mel's produced gas, nine lines have been built over the years to transport the dry gas, while four others transport condensate and LPG. The majority of the dry gas transportation capacity is dedicated to exports with some of the lines supplying the domestic market.

Since the seventies, Hassi R'Mel gas has been transported to the Mediterranean coastal ports of Arzew (to the north-west) and Skikda (to the north-east), for exports as LNG to the United States and Europe.

Table 3: Gas and Condensate/LPG transport pipelines from Hassi R'Mel

Pipeline	Length (km)	Diameter (in)	Comments
Hassi R'Mel – Arzew (GZ0, GZ1, GZ2, GZ3 &	507 – 509 (each line)	24 – 20 (GZ0) 40 (GZ1, GZ2)	Main gas pipelines from Hassi R'Mel to LNG

Pipeline	Length (km)	Diameter (in)	Comments
LZ1)		42 (GZ3) 24 (LZ1)	plants.
Hassi R'Mel – Skikda (GK1, GK2)	573	40 (GK1) 42 (GK2)	
Alrar – Hassi R'Mel (GR1, GR2)	956, 962	42 and 46	From Alrar gas fields to Hassi R'Mel.

In the eighties, Hassi R'Mel started supplying feedstock for a gas export line to Italy, with the Enrico Mattei pipeline, built across Tunisia and Sicily. This pipeline has an export capacity of 954 billion standard cubic feet per year.

In 1996, Algeria started operating its second export pipeline to Continental Europe. The Pedro Dan Farell was built across Morocco and the strait of Gibraltar to supply Spain and now has a transportation capacity of 388 billion standard cubic feet per year.

Commercial Data

Sonatrach is the operator of the field and carries 100% of the field equity on behalf of the state.

Investment Opportunity

As far as we are aware at this time there are no expansion or remediation projects planned.

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