



The devil is in the production details of Saudi Arabia

Posted by [Rembrandt](#) on June 23, 2008 - 9:30am

Topic: [Supply/Production](#)

Tags: [crude oil](#), [original](#), [saudi arabia](#) [[list all tags](#)]

Yesterday we have heard announcements by Ali-Naimi, the oil minister of Saudi Arabia, regarding future production capacity increments. We are to believe that Saudi Arabia will produce 12.5 million barrels per day at the end of 2009 and a potential 15 million barrels per day in the coming decade. How should such announcements be valued? Is this achievable? What is meant with production capacity? What type of liquids is Saudi Arabia referring to when talking about oil? In this post I attempt to answer these questions.

Saudi Arabia Crude Oil & Liquid Fuels Production

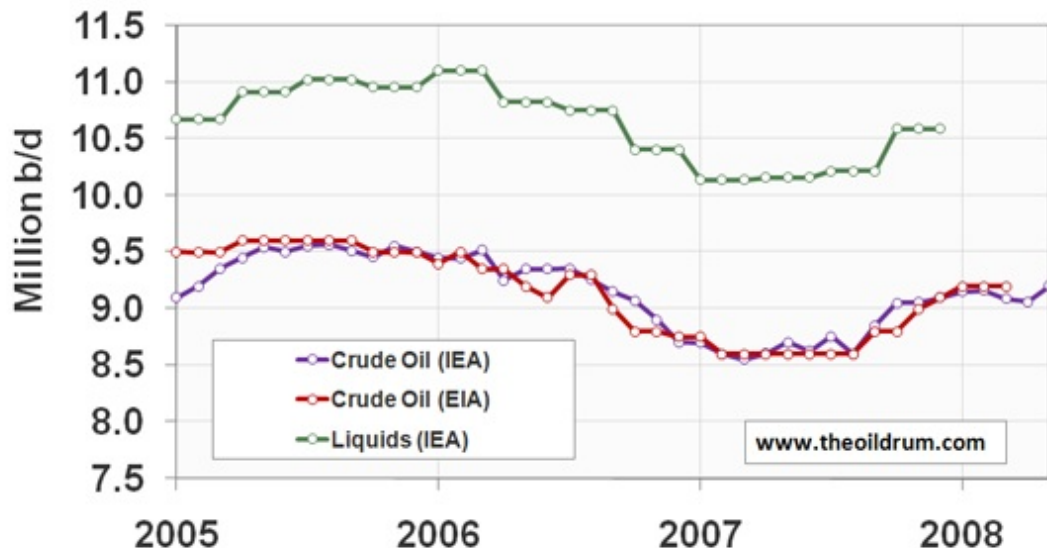


Figure 1 - Saudi Arabian production of crude oil (excluding lease condensates) & Natural Gas Liquids (including lease condensates) from January 2005 to May 2008

Setting the analytical scene - production capacity vs production and crude oil versus all liquids

When Saudi Arabia announces production targets it isn't using a clear cut definition of oil. Saudi Arabia produces two groups of hydrocarbons: crude oil and natural gas liquids. Natural Gas Liquids (NGL) are a group of hydrocarbons that fall between natural gas and oil - which consist amongst others of ethane (C₂H₆), propane (C₃H₈) and butane (C₄H₁₀).

The important difference is that crude oil can be refined into gasoline, diesel and kerosene while

NGL's cannot. These are mainly used as feedstock for the chemical industry. Therefore when Saudi Arabia increases crude oil it can influence oil markets heavily, but if it increases NGL's the impact is much smaller. *Point one to watch for is therefore whether production announcements refer to crude oil or to all liquids.*

A second point is that the country always talks about production capacity. *It is not very clear whether actual production or production plus spare capacity is meant.* Spare capacity is additional capacity that can be brought online within 90 days in case of an emergency (e.g when the US or Israel attacks Iran). The US Energy Information Administration and OECD International Energy Agency think that spare capacity of Saudi Arabia amounts to 1.5 to 2 million barrels per day. Whether this is the case or not is of course debatable, but for analysis of production it is less interesting.

Current Production of crude oil and Natural Gas Liquids

As shown in figure one, Saudi Arabia has not produced more than 9.5 million barrels per day of crude oil in recent years. In fact the last time Saudi Arabia produced more was 1981 when production briefly reached 9.65 million barrels per day.

The latest high of all Liquids production was 11.10 million barrels per day in the first quarter of 2006. We can establish from production data sources that last known production of total liquids was 10.58 million barrels per day in the 4th quarter of 2007 and last known crude oil production was 9.2 million barrels per day in May 2008.

Saudi Arabia Production January 2006 - May 2008 in thousand barrels												
2006	jan	feb	mar	apr	may	jun	jul	aug	sep	okt	nov	dec
All Liquids (IEA*)	11,103	11,103	11,103	10,828	10,828	10,828	10,752	10,752	10,752	10,408	10,408	10,408
Crude oil*** (EIA**)	9,400	9,500	9,350	9,350	9,200	9,100	9,300	9,300	9,000	8,800	8,800	8,750
Crude oil*** (IEA)	9,450	9,445	9,520	9,250	9,350	9,350	9,355	9,255	9,150	9,070	8,905	8,705
2007	jan	feb	mar	apr	may	jun	jul	aug	sep	okt	nov	dec
All Liquids (IEA*)	10,136	10,136	10,136	10,161	10,161	10,161	10,219	10,219	10,219	10,588	10,588	10,588
Crude oil*** (EIA**)	8,750	8,600	8,600	8,600	8,600	8,600	8,600	8,600	8,800	8,800	9,000	9,100
Crude oil*** (IEA)	8,700	8,600	8,550	8,605	8,705	8,625	8,755	8,600	8,850	9,050	9,055	9,100
2008	jan	feb	mar	apr	may	www.theoil drum.com						
All Liquids (IEA*)												
Crude oil*** (EIA**)	9,200	9,200	9,200									
Crude oil*** (IEA)	9,150	9,160	9,090	9,060	9,205							

*IEA = International Energy Agency **EIA = Energy Information Administration *** crude oil excluding lease condensates

table 1 - Saudi Arabian production of crude oil (excluding lease condensates) & Natural Gas Liquids (including lease condensates) from January 2005 to May 2008. For a data series from January 2002 to May 2008 [in excel format click here](#).

Crude oil and Liquids production of Saudi Arabia up to 2011

In 2005 [Saudi Arabia announced](#) that it wanted to reach a total liquids production capacity of 12.5 million barrels per day. Total investment done by Saudi Arabia to achieve this is 80 billion dollars, including necessary refinery infrastructure for heavy crudes, oil and gas separation facilities, pipelines and more. The production plans are as follows:

Project Name	Type	Grade	2P reserves		Max prod.	
			'000 barrels	'000 barrels	Discovery	startup date
Haradh III	Crude	Light		300	1948	Feb-06
Haradh III (condensate)	Condensate			150	1948	Feb-06
Hadriya, Fadhili, Khursaniyah	Crude	Light	3,210,000	500	1956	Apr-08
Khursaniyah Gas	NGL, ethane	NGL		250	1956	Apr-08
Hawiyah	NGL	NGL		310	1953	Apr-08
Nuayyim	Crude	Super Light	250,000	100	1990	Dec-08
Shaybah expansion phase I	Crude	Extra Light	7,000,000	250	1968	Jan-09
Khurais Phase I	Crude	33 API	8,500,000	800	1957	Jun-09
Khurais associated gas	Condensate			70	1957	Jun-09
Shaybah expansion Phase II	Crude	Extra Light	7,000,000	200	1968	Oct-10
Manifa phase I	Crude	Heavy	17,000,000	300	1957	Nov-11
Manifa Phase II	Crude	Heavy	17,000,000	300	1957	2013
Manifase Phase III	Crude	Heavy	17,000,000	300	1957	2013



Current Saudi Oil projects in the pipeline from 2006 - 2013
 Data from ASPO Netherlands Oil Database
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table 2 - Saudi Arabian crude oil and natural gas liquids projects from 2006 to 2013

So far Haradh III, Hadriya, Fadhili, Khursaniyah and Hawiyah have come onstream. Khursaniyah [faced a project delay of 5 months](#). The project was originally scheduled for December 2007 but the plant that would separate the associated gas from the oil was completed much later. Production finally [began on 22 april of 2008](#). These projects have so far not led to increases in production. On the contrary, production declined in the course of 2006. Perhaps due to heavy declines in the country from aging fields. Economist [James Hamilton from Econbrowser also offers a different explanation](#) worth reading. Namely that lower production levels would have been in the economic interest of the Saudi's due to the price-elasticity of petroleum demand in recent years.

But now the tide is turning. Saudi Arabia [announced in May that it would increase crude oil production](#) by 300,000 b/d to a level of 9.45 million b/d in June. Last week [another production increment](#) of 200,000 b/d to 9.7 million b/d of crude production was announced. This would take all liquids production of the kingdom to approximately 11.2 million barrels per day by July. This production increment is in all likelihood coming from the Khursaniyah oil field project that came on-stream in April. Because the additional production amounts to 500,000 b/d of light crude which is a similar amount as the announced production increments.

To see what will happen to Saudi crude oil and all liquids production up to January 2012 I have plotted monthly production figures from the investment program as per table 2 on top of expected future production from current oil fields. The latter is very difficult to forecast because no one has good data on decline rates for Saudi oil fields except the Saudi's themselves. Some Saudi statements were made in the press in the last few years about their decline. At one moment stating that annual decline that needs to be compensated is 700,000 b/d, at another moment talking about an 8% gross decline which thanks to infill drilling in current fields can be maintained at 2% annually. For purposes of giving a potential range of future production I have made two scenarios. One with a decline rate of 3%, the other with a decline rate of 6%:

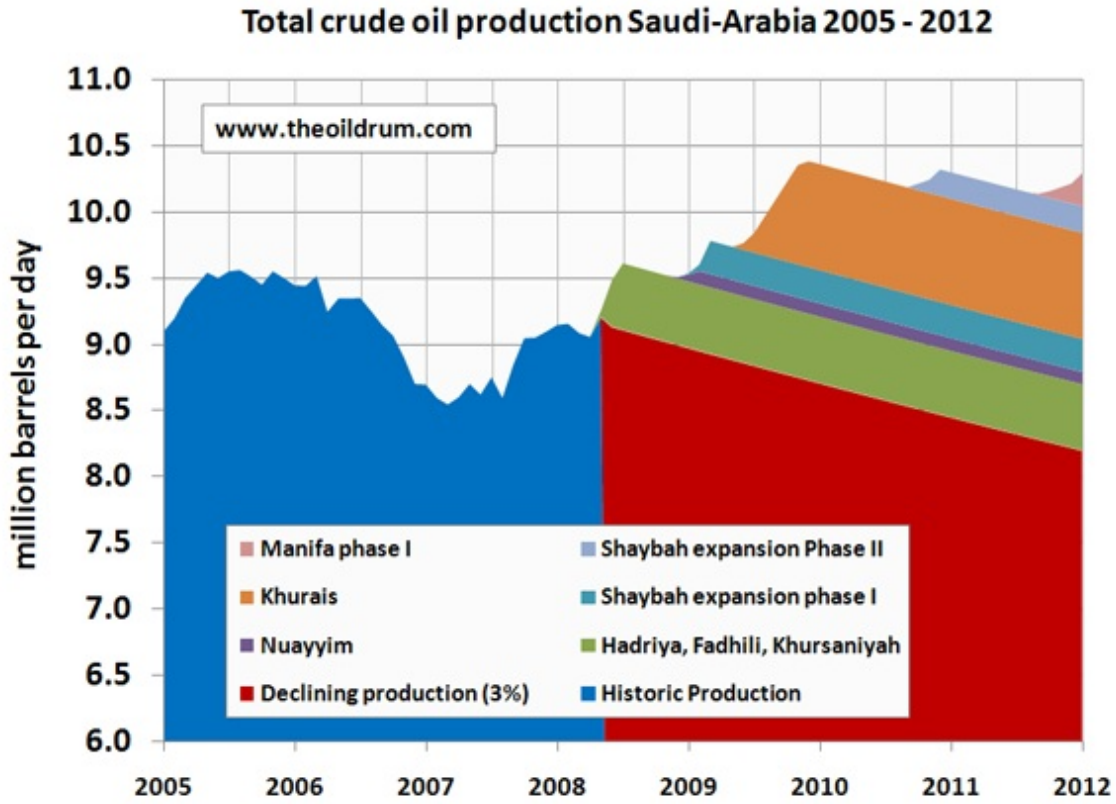


figure 2 - Saudi Arabia crude oil production projection from January 2005 to January 2012. Assumed decline rate is 3% for current production

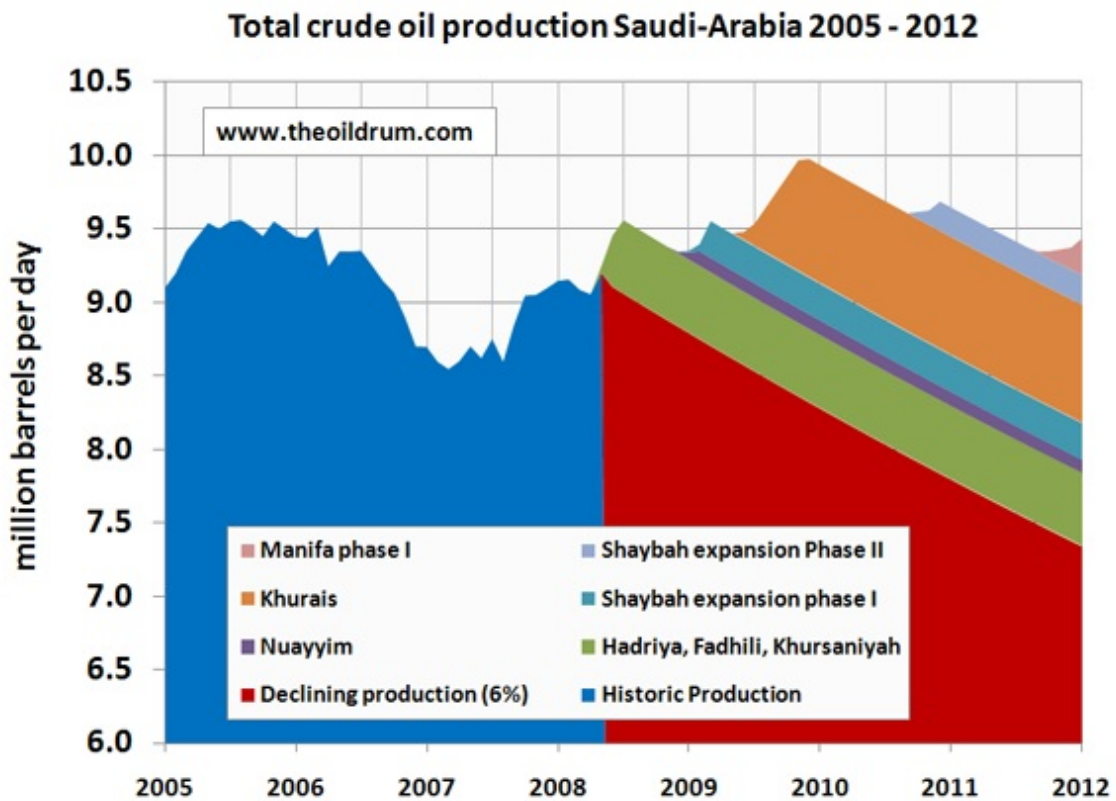


figure 3 - Saudi Arabia crude oil production projection from January 2005 to January 2012. Assumed decline rate is 6% for current production

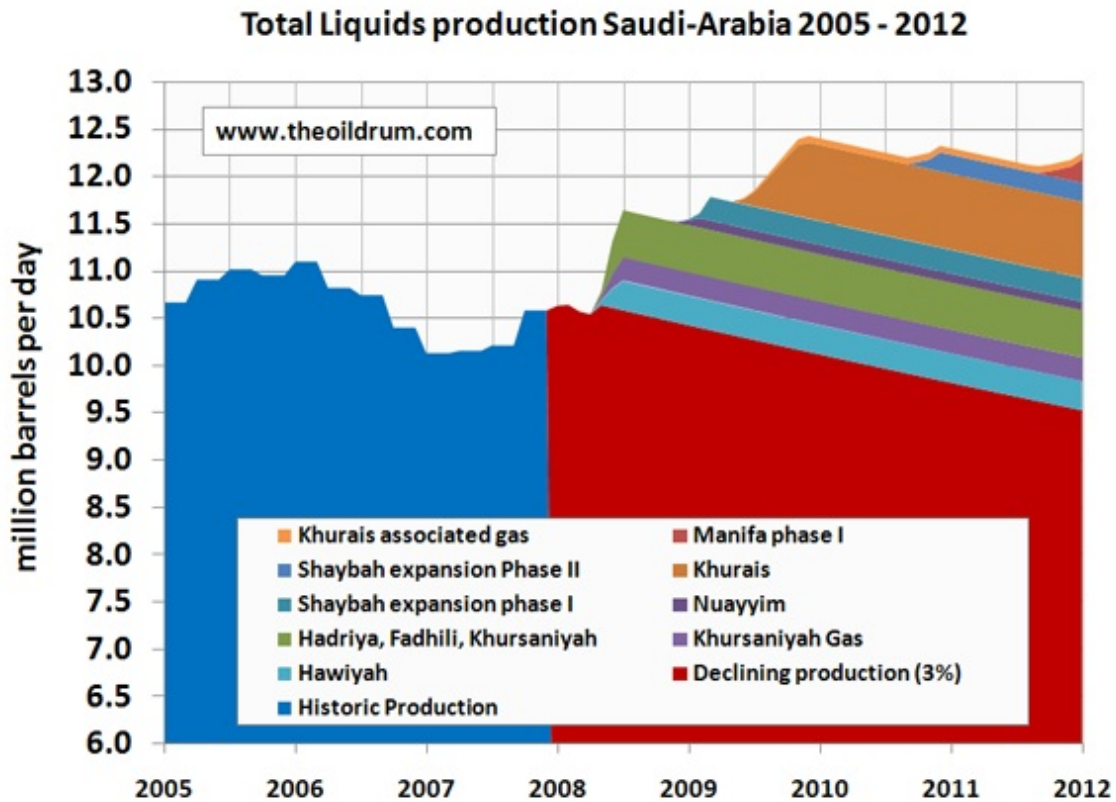


figure 3 - Saudi Arabia total liquids production projection from January 2005 to January 2012. Assumed decline rate is 3% for current production

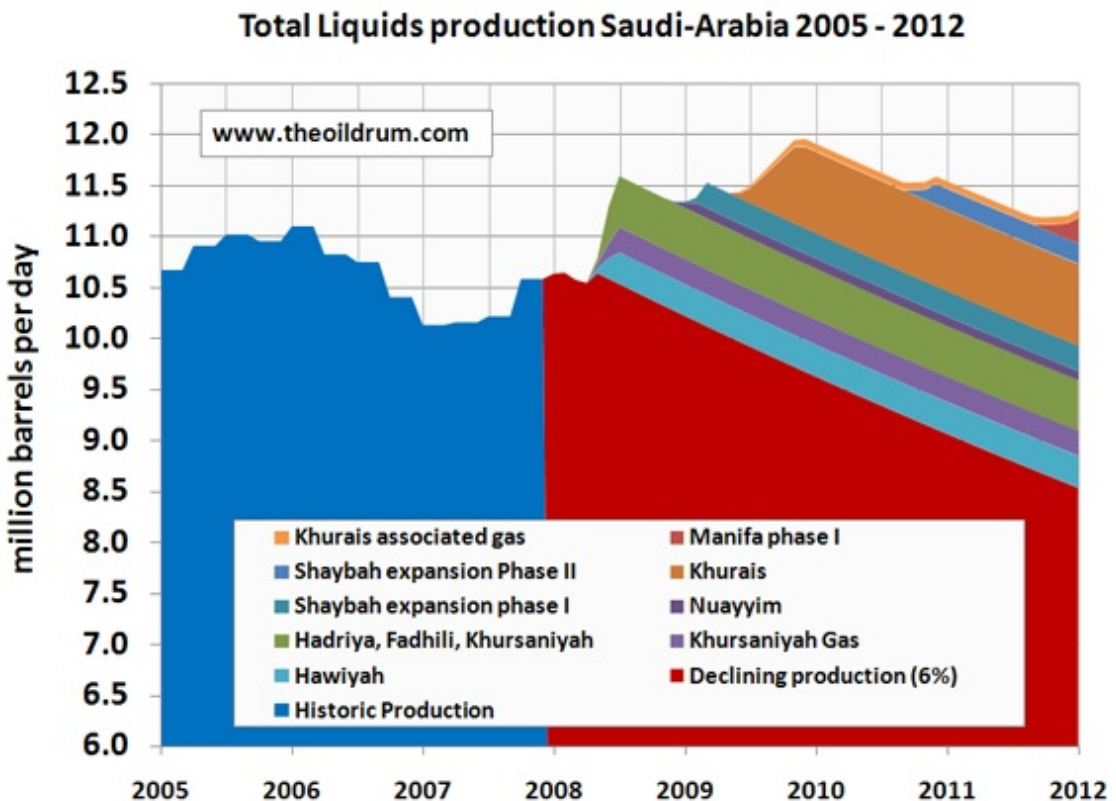


figure 3 - Saudi Arabia total liquids production projection from January 2005 to January 2012.

Assumed decline rate is 6% for current production

Production in the case of a 3% decline rate:

- Crude oil production reaches around 10.4 million b/d at the end of 2009.
- Total Liquids production reaches around 12.4 million b/d at the end of 2009.

Production in the case of a 6% decline rate:

- Crude oil production reaches around 10 million b/d at the end of 2009.
- Total Liquids production reaches around 12 million b/d at the end of 2009.

What we can conclude is that production of all liquids could reach 12.5 million b/d. But only if decline rates in currently producing fields are at a rate of 3% or lower and if all announced projects will come online on schedule. Especially the Khurais fields is of high importance given that it is supposed to increase production by 1.2 million b/d. In his thought provoking book about the oil fields of Saudi Arabia, [Twilight in the Desert](#), Matthew Simmons describes that the history of the Khurais field has been one of erratic production during the 1970s and 1980s. At maximum the field produced only 144,000 b/d in 1981 and a gas reinjection well program that started in 1983 didn't deliver much improvement. The field was mothballed not long after but is now back on the table for production to start around June 2009. Will the Saudi's succeed in unlocking Khurais full potential?

Production beyond 2011 - reaching 13.5 million b/d in 2015?

After Saudi oil minister Ali-Naimi spoke about the Saudi production targets at the Jeddah oil summit last Sunday, he also mentioned that Saudi Arabia can if necessary produce an additional 2.5 million barrels per day:

"Saudi Arabia will increase production capacity to 12.5 million barrels a day of oil by the end of next year and could add a further 2.5 million barrels a day if needed, from some new giant fields, Naimi said.

"The Saudi announcement of a possible increase in capacity to 15 million barrels a day is a robust statement; it would be a huge increase," ENI SpA Chief Executive Officer Paolo Scaroni said in an interview in Jeddah today. "The world is worried about the shortage in spare capacity and any improvement will change this sentiment."

The further daily capacity includes 900,000 barrels from the Zuluf field, 700,000 barrels from Safaniyah, 300,000 barrels from Berri, 300,000 barrels from Khurais and 250,000 barrels from Shaybah, Naimi said. ([Bloomberg](#))

Today's announcements sound nice, but are these new investment programs feasible? Zuluf, Safaniyah and Berri are all three old fields that have been producing for a very long time. It doesn't appear too likely that such high production increments will come to pass. Below are some excerpts from *Twilight in the Desert* about these three fields:

"The fifth Super- Giant: the zuluf oilfield - Zuluf is the northernmost offshore oilfield and Saudi Arabia's fifth super-giant. The average water depth at Zuluf is 118

feet. The field was discovered in 1965 and started production in 1973. Thirty years later, the field's production still comes primarily from its Khafji reservoir, a sandstone formation that generally consists of two production horizons, the Khafji main sand and the upper Khafji stringer. Periodic reports hint that Zuluf's production is around 400,000 to 500,000 barrels a day. Zuluf was the last great Saudi Arabian field to reach oil production in the half-million-barrels-per-day range. By 2004, the field had clearly become very mature and was exhibiting an array of aging problems that will tend to get worse over time."

"Zuluf's Khafji reservoir has now developed a gas cap overlaying the oil in both the field's stringers and its main sand. In some areas of this field, the reservoir pressure has fallen to its bubble point, and gas encroachment is starting to limit oil flows in some wells. According to this paper [2001 SPE paper], this gas problem can be addressed most effectively by increasing the duration and frequency of all Zuluf well tests so the problem can be spotted before it becomes severe. The problem can then be mitigated by decreasing the well's output. The problem can also be countered by cementing the wellbore and sidetracking a new well at a deeper level further from the gas. But as was the case with the Safaniya oilfield, a shortage of barges needed to perform the well tests has actually led to a decrease in testing instead of an increase."

"A 2004 SPE paper of Zuluf reported that there were now 270 producing wells in the field. It described the main Khafji sands as being 200 to 300 feet thick, but current drilling is taking place in the thin upper khafji stringer. The good news is that these tiny pockets of oil have never been exploited, Until advanced technology wells were available, the oil was uncommercial." *M. Simmons, 2005, Twilight in the Desert, page 201 - 203, Wiley, ISBN: 0-471-73876-x*

"The Safaniya oilfield: "Queen of Sand" Safaniya was discovered just off the coast of the Arabian Peninsula in 1951 about 125 miles north of Dharan. The primary producing reservoir is the Safaniya, a Cretaceous sand in the Wasia formation. Safaniya is not only Saudi Arabia's second most productive oilfield, it is also the world's largest offshore oilfield...It was brought into production in 1957 at about 25,000 barrels per day. So far, after a half-century of production, almost all of Safaniya's oil still comes from the Safaniya formation reservoirs. By 1993, there were a total of 624 wells in the field. When Saudi Arabia's oil production peaked in 1980-1981, Safaniya was producing over 1.5 million barrels of oil per day. Today, the field still apparently produces around 600,000 barrels per day. Safaniya is Saudi Arabia's primary supplier of heavy oil (with an average API gravity of 27 degrees)... By the end of 2004, the only apparent spare production capacity in the kingdom consisted of heavy oil. A high percentage of this capacity probably draws from the remaining oil left in Safaniya."

"Safaniya's oil wells produced almost water-free oil until the late 1980's according to a 1988 SPE report, which said, "Until recently, production problems like wet crude, sand production, lack of reservoir energy, etc., had been relatively minor issues." By 1998, technical papers addressing issues at Safaniya began describing the field as reaching a mature state of depletion... A 1999 SPE paper presented the findings from the first full-scale 3D field model of Safaniya. The modeling objective was to more accurately predict the future production performance of the overall reservoir, the performance of individual wells with regard to water coning, the scope and rate of water encroachment,

and the volumetric waterflood sweep efficiency. This modeling also began to address why much of Safaniya's oil was being bypassed due to water encroachment. The paper shed light on the timing and the number of additional infill or development wells that would be needed as the field is depleted, and it identified areas of this great field that would have to be switched from free-flowing wells to artificial lift. This change does not mean that Safaniya's oil flow will end, but it does signal a step-wise increase in costs."

"Since Safaniya never produced more than just over 1.5 million barrels a day and last did this almost 25 years ago, the chances that output of that level could be achieved again and sustained for any length of time must be considered remote." **M. Simmons, 2005, *Twilight in the Desert*, page 187 - 191, Wiley, ISBN: 0-471-73876-x**

" The Berri oilfield: "A Watery Prince" Berri was discovered in 1964 with oil bearing reservoirs in the Arab A,B, and C zones beneath the onshore part of the field. Sadly, these reservoirs have never been productive. The significant reservoirs that have provided all of Berri's commercial output are offshore: Hanifa, Hadriya and Fadhili. All were found in 1967."

"Following production startup, the high initial reservoir pressure went into rapid decline, falling from almost 4,000 psi in 1970 to 2,600 in 1973. At this rate of descent, the reservoir would have reached bubble-point pressure within two years. To prevent this, a peripheral water-injection program was begun in 1975. The water-injection program enabled a significant increase in production at Berri:

- Prior to water injection, Berri produced 155,000 barrels a day in 1971 and 300,000 in 1972.
- After water injection began, production rose to 800,000 barrels a day in 1976.

In 1977, less than two years after the start of the injection program, water began to break through in the first row of producing wells nearest the flood front. Initially, the completions in the wet zone were plugged off, and the wells were recompleted in drier zones higher up the wellbore. A moderate amount of water production could be tolerated in each well once wet crude handling facilities were installed at the Berri Gas & Oil Separating Plant (GOSP). For some time thereafter, the typical water cuts stayed around 20 percent, although the flood front was advancing rapidly to the crestal area. The available record of Berri's production history contains the following benchmarks:

- In 1976, Berri's output peaked at 800,000 barrels per day and then began to decline rapidly.
- By 1981, when Saudi Arabia's overall oil output peaked, Berri's production had already fallen by 30 percent.
- By 1990, 25 percent of Berri's producing wells had totally watered out, choking off the oil flow and forcing Saudi Aramco to shut in the wells."

"Reservoir and production experts working this once great field assume that large amounts of bypassed oil are present in the middle and lower parts of the Hadriya; but even with modern oilfield technology, recovering these remaining oil deposits is expensive, and the oil flows rarely approach those of the oil wells before they water out. Aramco had always believed that the Fadhili reservoir, lying below the Hadriya rocks,

was not commercially exploitable. But in 2000 Saudi Aramco technicians began reevaluating whether it might now be economical to drill and produce this lesser-quality reservoir as Berri's prime producing areas deplete." ***M. Simmons, 2005, Twilight in the Desert, page 192 - 197, Wiley, ISBN: 0-471-73876-x***



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