



Tech Talk - Saudi Arabia and What Lies Ahead

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Topic: [Supply/Production](#)

Tags: [decline rate](#), [depletion](#), [ghawar](#), [jubail](#), [manifa](#), [saudi arabia](#), [shaybah](#), [sinopec](#), [yanbu](#) [[list all tags](#)]

Saudi Aramco has stated that it designs the well layouts and extraction patterns from its oil fields so that they effectively [decline at a rate of 2% per year](#).^{*} If one divides 100 by 2 it yields 50. If one subtracts 50 from 2012, one gets the year 1962. Even for those with poor math skills, these are not difficult operations, and they lead to the conclusion that those fields which came into production in the early 1960's and earlier are now reaching the end of their productive lives. They are not there yet, since production took time to ramp up, and some fields have been rested over the years when production was cut back, or even mothballed. But this gives you some perspective on the overall scope of the situation, without the need for complex mathematical modeling.

		Discovery	First production
Dammam		1938	1938
Abqaiq		1940	1946
Ghawar			
	Ain Dar	1948	1951
	Haradh	1949	1964
	Uthmaniyah	1951	1956
	Shedgum	1952	1954
	Hawiyah	1953	1966
Qatif		1945	1951
Safaniyah		1951	1957
Khurais		1957	1959
Khafji		1960	1961
Abu Hadriyah		1940	1963
Fadhili		1949	1964
Manifa		1957	1964
Khurasaniyah		1949	1965
Abu Sa'fah		1963	1966
Berri		1964	1970
Zuluf		1965	1973
Marjan		1966	1974
Hawtah		1989	1994
Shaybah		1968	1999
Nuayyim		1990	2009

Figure 1. Table of oil fields in KSA and their start dates

(*The IEA apparently believes that the figure is [closer to 3.5%](#)) (H/t [Matt](#)) Saudi Arabia states that, without using advanced recovery techniques and “maintain potential” drilling sites – often not in the same field as that being depleted – the rate [would be 8%](#).(h/t [Darwinian](#)).

In earlier production practices, where companies “stepped out” production wells away from the original producers, and gradually extended their knowledge of field size, reserve growth over time was a normal development. However, with the large size of the fields in Saudi Arabia, and the need to maintain operational pressure during production, Aramco (as JoulesBurn has clearly shown) rings their fields with water injection wells that drive oil to the central high point of the reservoir, slowly migrating the producing and injection wells towards that center as the field is drawn down. This practice precludes the incremental increase in reserves over time, since the field boundaries are constrained. As the wells reach the central part of the reservoir (the crest of the anticline) a clear definition of the closing days of the field becomes more evident.

At the same time it is worth pointing out that until fairly recently, when Aramco were carrying out their “maintain potential” drilling, they were merely drilling additional wells at 1 km, spacing further down the reservoir. But when one moves from the perimeter of the reservoir to the crest, then there are no more places within that reservoir to continue the practice. Thus, in more recent years, Aramco has offset declines in older reservoirs by bringing new fields into production. But as the illustration that JoulesBurn has provided for Haradh 3 shows below, in the smaller reservoirs it is no longer possible to have the space for multi-year progressions of the wells across the field, and thus, to sustain production, new fields will have to be added to the network at more frequent intervals to sustain levels of production.

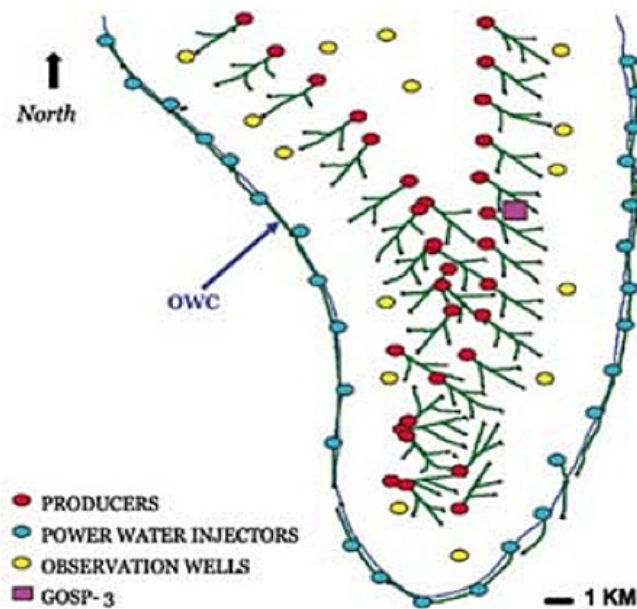


Figure 2. Planned well layout in Haradh III (from Aramco via [JoulesBurn](#))

Saudi reservoirs have also been large. This brings with it the need for large infrastructure, not only to remove the oil, but also to separate the oil, gas, and water (and occasional sand) that come from the well, and to inject water into the reservoir to replace the oil and maintain the reservoir pressure that drives the fluid to the well. That infrastructure is tied to specific design flow rates and it is difficult to change the volume flow rates by significant amounts at short notice. Thus, when a field such as Abu Sa'fah, for example, is brought on line to produce 300 kbd, the plant is completely designed for that flow and there is no immediate way to handle an increase in flow. Therefore, Aramco can only produce to the capacity of the infrastructure in place. It is this

requirement and “step-function” nature of the additions to oil flow that provides some of the shape to the flow of oil in the region.

However, it is also a limitation in that the two remaining large sources of crude oil that Saudi Arabia anticipates coming on line must wait until all the logistical handling is in place.

The first of these is the Shaybah expansion. Shaybah began with a production of 250 kbd, and has seen this progressively increased, first to 500 kbd, and then, in 2009, [to 750 kbd](#). The expansion requires that [additional plant be installed](#) to process the hydrocarbons produced which will include 264 kbd of NGL. The [anticipated completion date](#) is in 2014.

[Manifa](#) has been the more controversial of the fields in Saudi Arabia for some time. Although it has been known to exist for a long time (see above table) and was [initially brought into production](#) in 1964, it has never seen the major thrust to develop production that is now underway. There have been several reasons for this, the primary one being that KSA has never needed the production in the past to be able to meet anticipated demand. However, there have also been significant questions as to the make-up of the oil, and its need for special treatment. In 2005, back in the days when KSA was admitting to a decline rate of 6%, it was producing at [around 50 kbd](#). JoulesBurn has written about the controversy over the [make-up of the oil](#), which is a heavy, sour crude containing vanadium. Regardless of the validity of those arguments, it does appear that the oil is now going to be fed as it is produced to two new refineries that have been planned in the Kingdom. These are at [Jubail](#), which is expected to be completed in 2013 and will handle 400 kbd of oil, and the second [at Yanbu](#), which, as of this year is being developed [with Sinopec](#), ConocoPhillips having pulled out of the deal. Those together comprise some 800 kbd of the 900 kbd of oil that Manifa is being developed to produce.

It is pertinent, relative to the opening comment, to note that this is the last large project that Saudi Aramco has reported to be on their books. If one were to accept that their real decline rate is some 3.5%, then, at a production level of roughly 10 mbd a year, this would be reducing at 350 kbd per year. A 1.2 mbd addition to current production (Manifa and Shaybah combined) would thus only match just over three years of such a decline rate. For there to be new sources of production brought on line in the future, there must first be a considerable infrastructure put in place, and there does not at present appear to be any evidence of this, nor planning and bid documents being prepared for such an eventuality. Remember that Aramco began [construction for Manifa](#) in 2007, and it is still likely at least a year from major production.

To some extent this can be overcome by feeding new production from fields not now in production into the existing GOSPs and related facilities. But this implies that production will not grow beyond its current levels at around 10 mbd. Aramco has become very skilled at controlling water floods, enhancing production from existing reservoirs and previously bypassed oil, but those wells can only be revisited a limited number of times. Because of the large number of highly productive wells the country has, it is possible in the short term to raise production, but that increase has to go through production facilities that are of only limited volume. Thus the increase can be of only a short duration, and as has been commented by others in the past few weeks, a system cannot be run at full production for long without problems developing. Furthermore, the underlying assumption that production declines can be offset by new production to hold depletion to 2% a year is really only true for the country as a whole, and individual decline rates for specific reservoirs have been reported to run between 6 and 8%. As there are fewer large projects to provide the offset for such decline rates, then the impact of the greater values will become more evident. And so, while I expect that the Kingdom will reclaim its position as leading oil producer before long, I continue to believe this will happen because of a drop in Russian production rather than a gain in from the Kingdom.



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