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Past and Future at Total's Elgin/Franklin Project

Posted by JoulesBurn on April 25, 2012 - 11:00am
Topic: Supply/Production

Four weeks after the Elgin G4 well sprung a leak above the production platform in the North Sea, Total has spudded the first of two relief wells as backup in case the attempt to kill the well from above doesn't work. It will take 6 months to drill the wells, however, and an estimated 200,000 cubic meters of gas per day was initially being released, and reportedly enough so far has leaked to heat all of Aberdeen for a decade (a suspect claim, perhaps).

In this post, I will provide some additional background on the history of this project and what Total E&P UK's plans were prior to the leak and subsequent shutdown of all production.

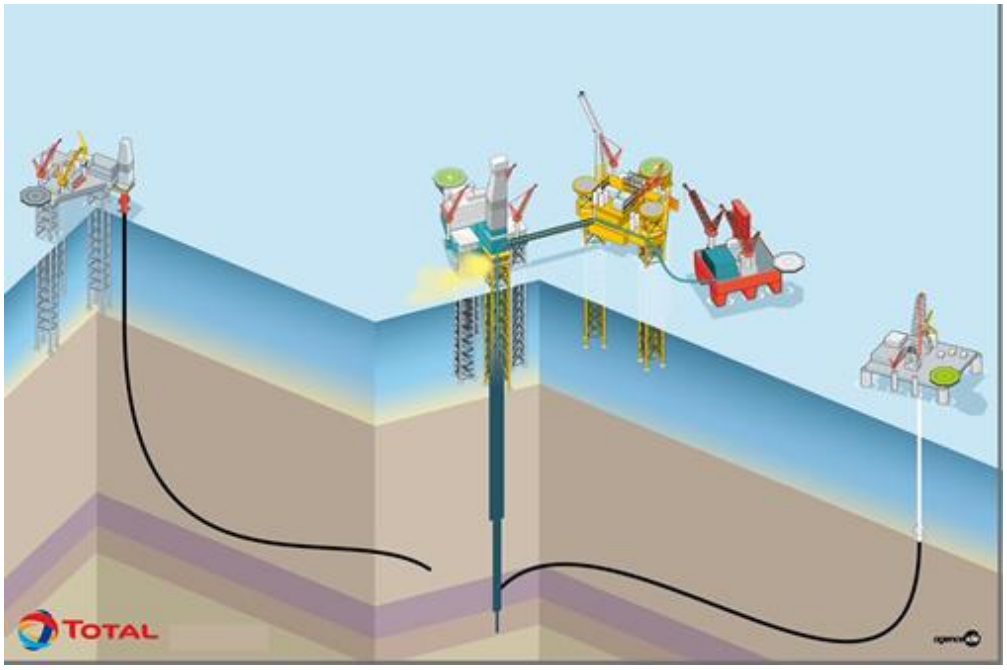

Figure 1: Relief well plan for Elgin G4. Source: Total

In my previous report on Elgin, I gave a brief description of the facilities. There are currently two wellhead platforms, one (with the leak) tethered to the Elgin PUQ platform with a bridge, and the other connected to the PUQ [production-utilities-quarters] platform with underwater pipelines (Fig. 2).

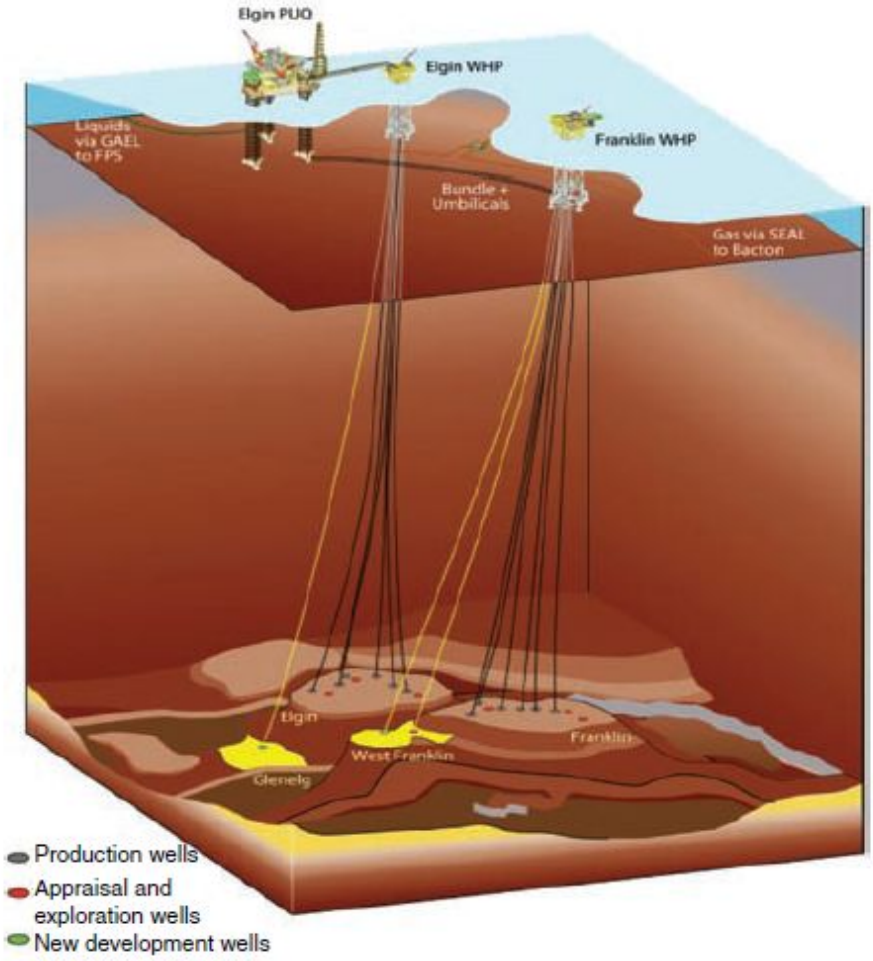

Figure 2: Elgin/Franklin Project.
source: Journal of Petroleum Technology, 2011

Some noteworthy items in this graphic:

- The Franklin wellhead platform is 5.4 km from the Elgin PUQ and wellhead platform
- According to this publication, in 2011, seven production wells are tethered to the Elgin platform: six in the Elgin field and one in the Glenelg field. Note that there are a total of 12 well slots on the Elgin platform.

The original plan is described in Elgin/Franklin: What Could Have Been Done Differently? (third article in pdf, hence referred to as WCHBDD).

> The development was based on 12 wells (seven on Elgin, five on Franklin) and included the recovery of two predrilled appraisal wells. Provision was included for a second Elgin wellhead platform, also bridge connectable to the process utilities and quarters (PUQ) platform, to be installed later if warranted.

Information on the wells drilled for this project are available from the UK government. Shown in Table 1 are those which were drilled near where the Elgin platform is now located, and which could potentially occupy slots.

WELLREGNO	SPUDDATE	TDREACHED	COMPLETED	OPERATOR	FIELD
22/30c- 8	8/18/90	2/24/91	5/24/91	ELF EXP	Elgin
22/30c- 10	5/25/92	11/23/92	3/29/93	ELF EXP	Elgin
22/30c- 13	12/30/93	8/6/94	2/6/95	ELF EXP	Elgin
22/30c-G4	3/24/97	10/27/98	1/12/99	ELF EXP	Elgin
22/30c-G5	6/3/97	7/8/97	7/11/97	ELF EXP	Elgin
22/30c-G6	3/18/98	5/28/98	6/18/98	ELF EXP	Elgin
22/30c-G7	6/18/98	7/16/98	7/16/98	ELF EXP	Elgin
22/30c-G8	7/19/98	7/30/98	7/30/98	ELF EXP	Elgin
22/30c-G8Z	7/31/98	10/21/98	10/21/98	ELF EXP	Elgin
22/30c-G8Y	10/22/98	2/21/99	3/21/99	ELF EXP	Elgin
22/30c-G9	7/29/00	11/17/01	1/18/02	TOTAL E&P	Elgin
22/30c-G10	1/24/05	3/19/05	4/2/05	TOTAL E&P	Glenelg
22/30c-G10Z	4/2/05	5/9/05	6/3/05	TOTAL E&P	Glenelg
22/30c-G10Y	6/3/05	11/9/05	3/12/06	TOTAL E&P	Glenelg
22/30c-G11	11/1/08	7/14/09	9/12/09	TOTAL E&P	Elgin
22/30c-G12	9/17/09	2/20/10	4/14/10	TOTAL E&P	Elgin

Table 1: Wells potentially connected to Elgin platform.

The first three wells were exploration wells, and were subsequently named G1, G2, and G3. It was hoped that these could be used as producers, but this did not work out in the end. In the main development phase, wells G4-G8 were drilled prior to any production. However, the first attempt with well G8 experienced problems, and must have been sidetracked (G8Z) and then again (G8Y). Well G9 was completed sometime after production started in 2001, and thus only 3 empty slots were available at the beginning of 2002. As WCHBDD reported:

> Failure in recovering Elgin appraisal wells meant that a total of only six slots remained available for future drilling (three on Elgin and three on Franklin), instead of nine as planned.

The nearby Glenelg field was discovered in 1999, and a production well tethered to the Elgin platform was drilled in 2005-2006 (again after 3 tries). G11 and G12 are recent infill wells into the Elgin field.

This would imply that all 12 slots were then occupied. Time for the 2nd Elgin platform. A recent Total presentation revealed that development of additional facilities was under way, including a second Elgin platform and one for the West Elgin field as well. Indeed, the installation of the platform jacket (the supporting tower) was supposed to take place in September of this year.

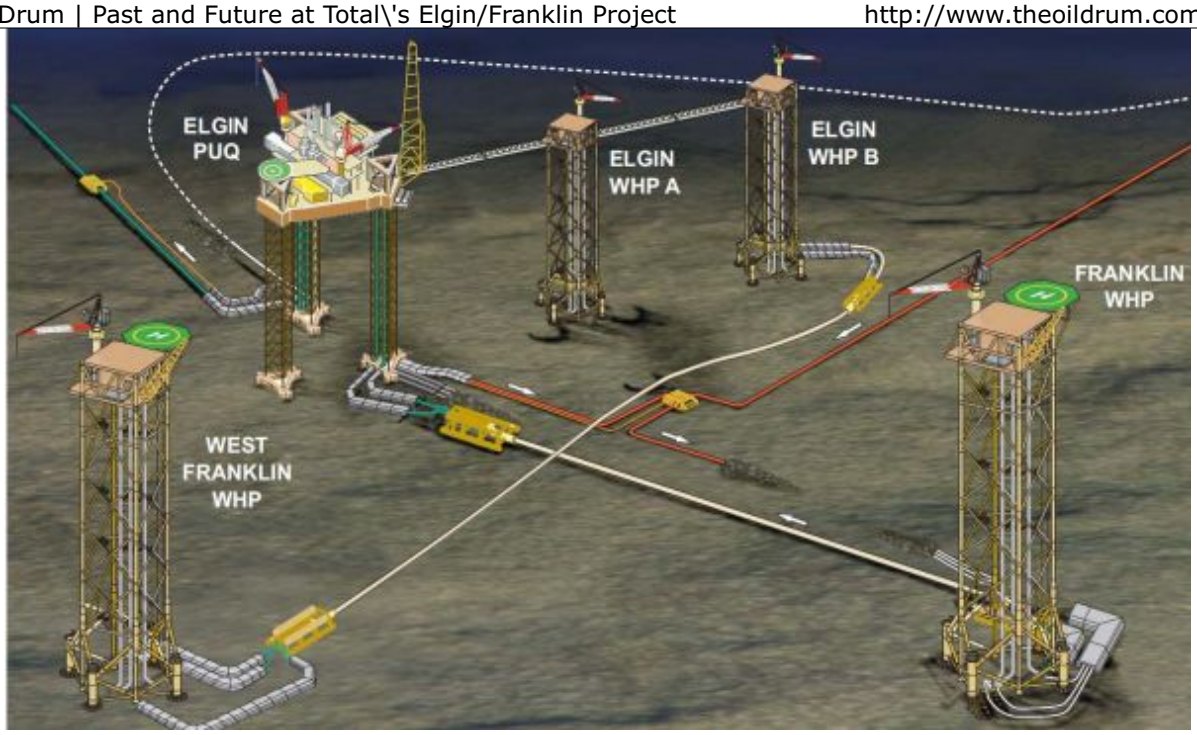

Figure 3: Elgin/Franklin current and future infrastructure

But let's go back a few years. Things were off to a good start, according to WCHBDD:

> Overall, the Elgin/Franklin asset was off to a good start when first production began in 2001, with expected production already higher than planned at project sanction.

Unfortunately, not all of the original producers lived into old age. A presentation (6 MB pdf) by JL Bergerot of Total in February of this year had this plot (Fig. 4):

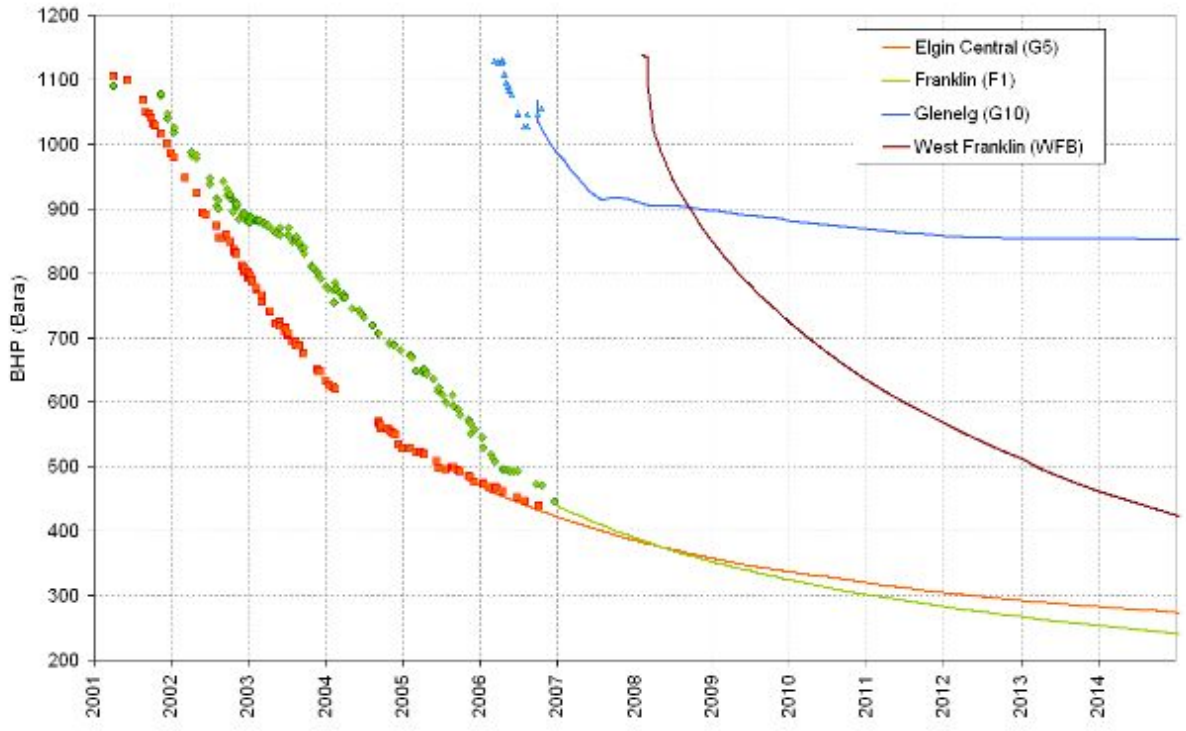

Figure 4: Elgin/Franklin wells that ended not so well.
(click image for larger version)

The slide had the following text:

> Why is HPHT [high pressure high temperature] infill drilling challenging ?
> Drilling infill wells in Highly Depleted Reservoir is a strong challenge.
>
> - unability to achieve reliable wells on some fields (loss of 3 wells due to liner full collapse, 1st infill stopped due to a technical difficulty)
> - serious troubles on a field depleted by 140 bars only.
>
> Very rapid and important depletion is usual on HP/HT fields

The reservoir started out highly overpressured, but then drops rapidly with production. Well G5 and the G10(Y?) wells apparently died in late 2006 due to liner collapse.

A Total presentation at the 23rd World Gas Conference in June 2006 had this map (Fig. 5):

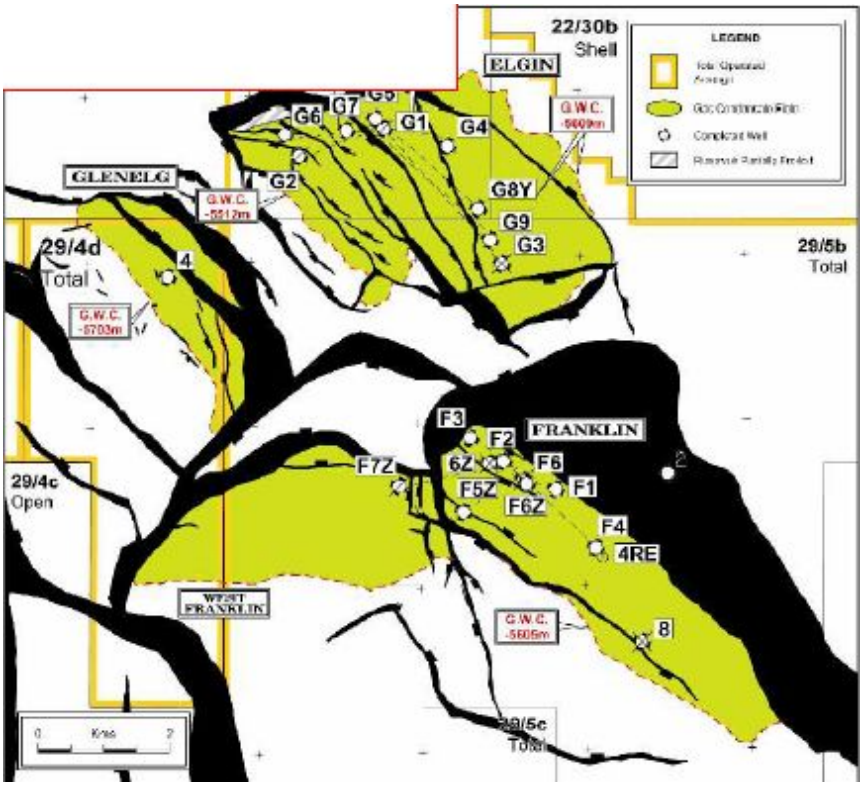

Figure 5: Elgin/Franklin wells showing status

Note that the Elgin wellhead platform is directly over the G1 well (and the Franklin platform over the F2 well). This map is from about 2006, and shows more detail on the delineation of the fields. A seeming differentiation is made between shut in wells (G1 and G2) and a fully killed well (G3).

And I found other tidbits: On 17 August 2011, the North Sea Reporter reported "On Elgin, the Rowan Viking continues with slot recovery work in well 22/30c-G8y". And one person's LinkedIn page has this:

> Working back on Elgin Franklin as wireline supervisor on the G8 well kill and slot recovery programme following the unexpected separation of the production tubing. This was an extensive programme, which involved a lot of unique one off, tooling to permit access to the production tubing and prepare the well for slot recovery at a later time via a drilling rig. This took almost 3 months altogether and was delivered successfully and safely in collaboration with a number of other contractors to the client. The installed assemblies were later recovered successfully when the Drilling Rig Rowan Viking was brought in to recover the slot.

So well G8 is dead as well, and the slot was being freed up for reuse within the last year. One more from LinkedIn (since July 2011):

> Lead the planning of challenging infill HPHT development wells: Elgin Infill C (high depletion, sour environment, **slot recovery with live annuli**, coil tubing killing, first Elgin well abandonment), West Franklin C/D/E (T° ± 223°C, new material and connections qualifications, compaction mitigations, pipe in pipe architecture solution, pre-drilling with deep tie-back and tie-back at MLS...)

Possibly the same G8Y well, but strange that it would be referred to as infill. Live annuli?

The Dreaded Hod Formation

Two problems seem to have been evident for a long time. The first is the rapid pressure depletion, which has resulted in well deformation and death, plus makes it difficult to drill infill wells as the "mud window" between the formation pore pressure and the fracture gradient disappears. Although the reservoir is depressurized, the cap rock above is not. So a certain mud weight is necessary to contain the well during drilling above the reservoir becomes excessive when drilling through the reservoir, possibly leading to mud circulation loss and formation damage. From another Bergerot presentation:

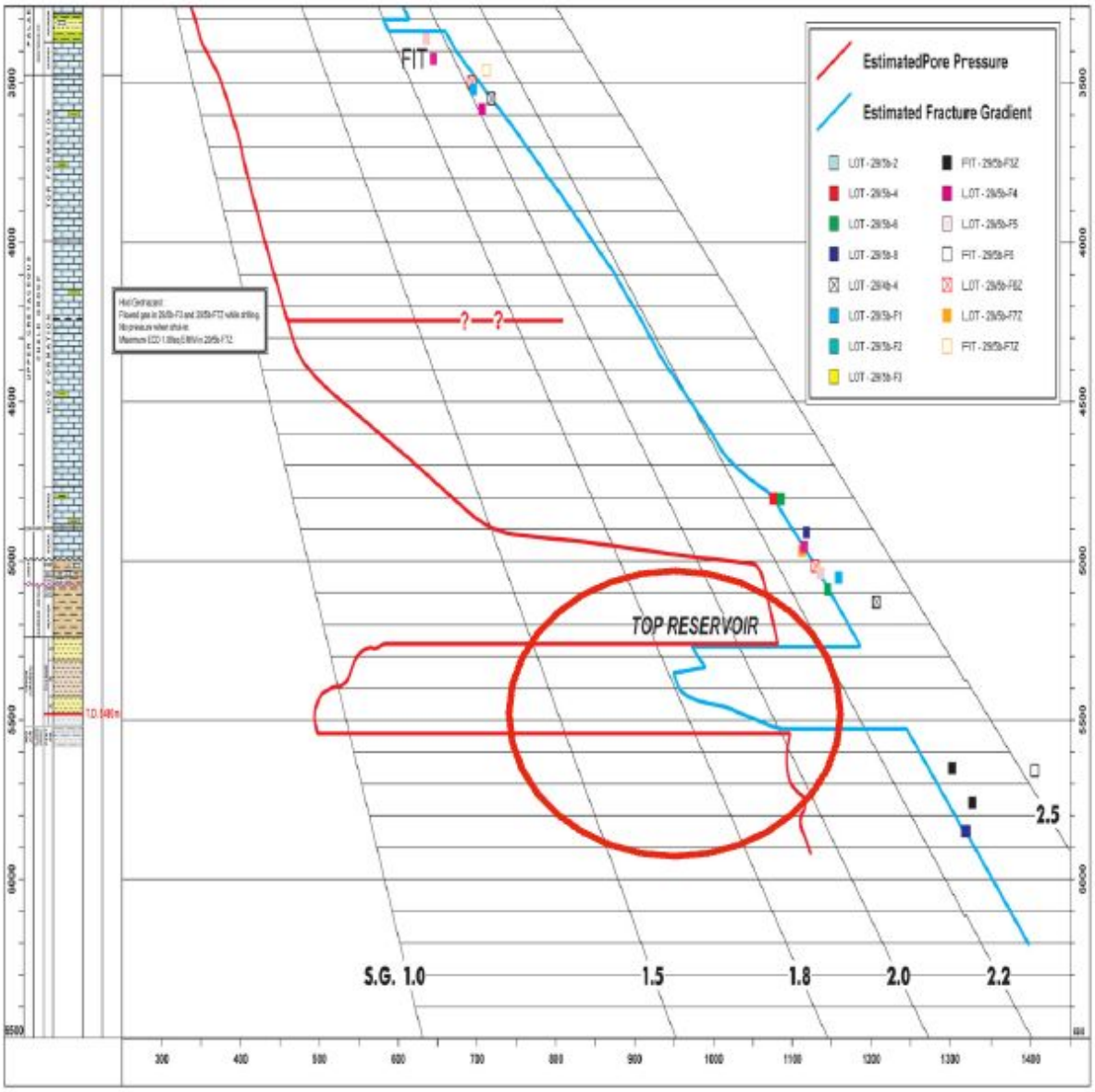

Figure 6: Mud window loss and Hod formation.

Fig. 6 shows the situation with the reservoir depressurized by production. But note that spike at about 4250 meters. This thin overpressurized Hod zone is what is believed to be causing grief on well G4, and has been a problem from early on. The text box next to it reads:

> Hod Geohazard
> Flowed gas in 29/5b-F3 and 29/5b-F7Z [Franklin wells] while drilling
> No pressure when shut in
> Maximum ECD 1.88sq EMW in 29/5b-F7Z

From Predicting Effects of the Hod Geohazard:

> Because the gas-bearing Hod limestone is overpressured and tight, gas is able to percolate into the wellbore during drilling and also during completion operations when

> the casing is depressurized. Realizing that cemented casing was unlikely to hold gas back during well production lifecycles, casing-annulus pressure-management systems were installed on the facilities. In addition to increasing awareness of the Hod gas influx during drilling, fit-for-purpose mitigation plans were conceived.

There are some Hod-related references in an extended abstract from an HPHT meeting in 2009:

> 22/30c-G11, was drilled in 2009 into the Elgin Field with a depletion in the order of 700bars. This well planned for the events that occurred in 29/5b-F8Z, but also contingency planning for high gas levels in the cap rock as this had been encountered in a number of the development wells. Whilst drilling, gas events were encountered much higher and more continuously, from the top of the Hod Formation and at further intervals throughout this Formation. The origin of these unexpected gas events is still under investigation.
> ...
> This well was eventually successfully completed and brought into production in October 2009.

Finally, there are two questions I have involving this image (Fig. 7) of the leaking wellhead:

Figure 7: Leaking Elgin wellhead

1. What is that yellow stuff?
2. How did/does it form?(recalling that the Hod formation gas does not have significant H_2S)

It has been reported that the rate of gas leaking from the well has decreased by two thirds (or perhaps that the estimate is 2/3 less), but the actual headline says more about the current state of energy journalism than anything else.

Total says gas leak cut to a third after relief work