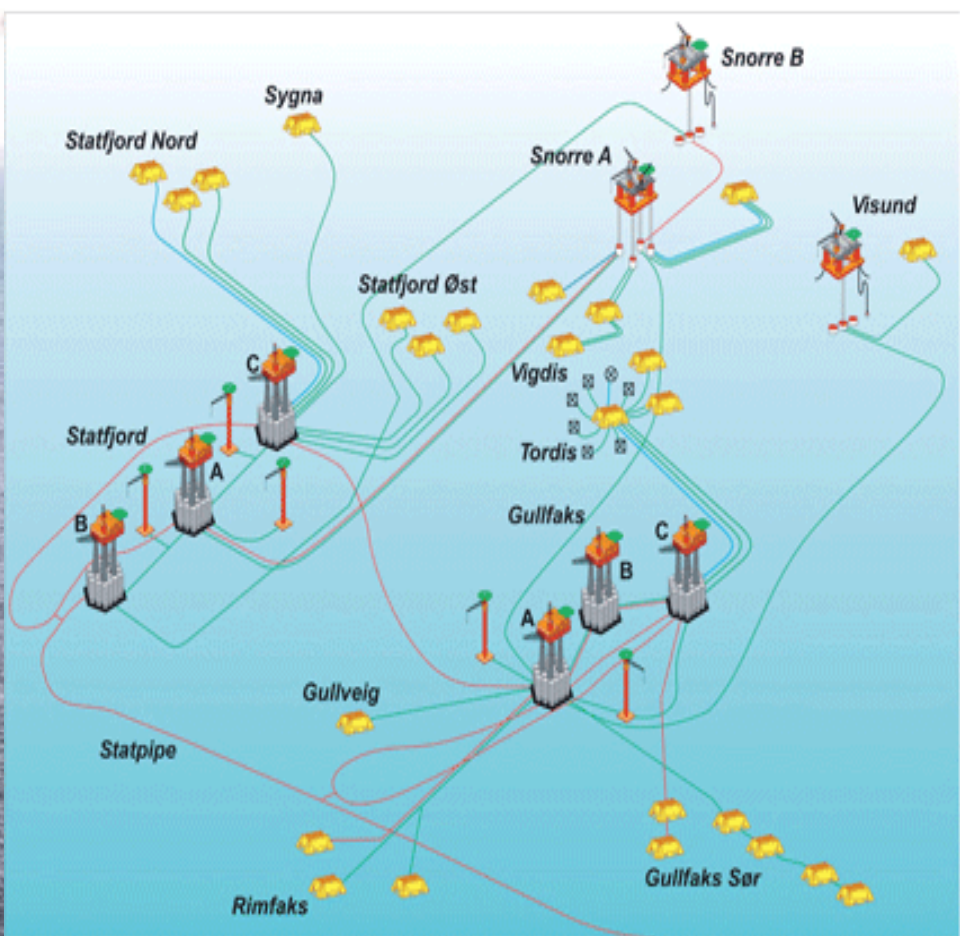


Statfjord A PP&A PAF 14.06.2012

Tore Weltzin, Department Leader Statfjord

Statfjord A



SFA PP&A - Barrier philosophy

Surface plug

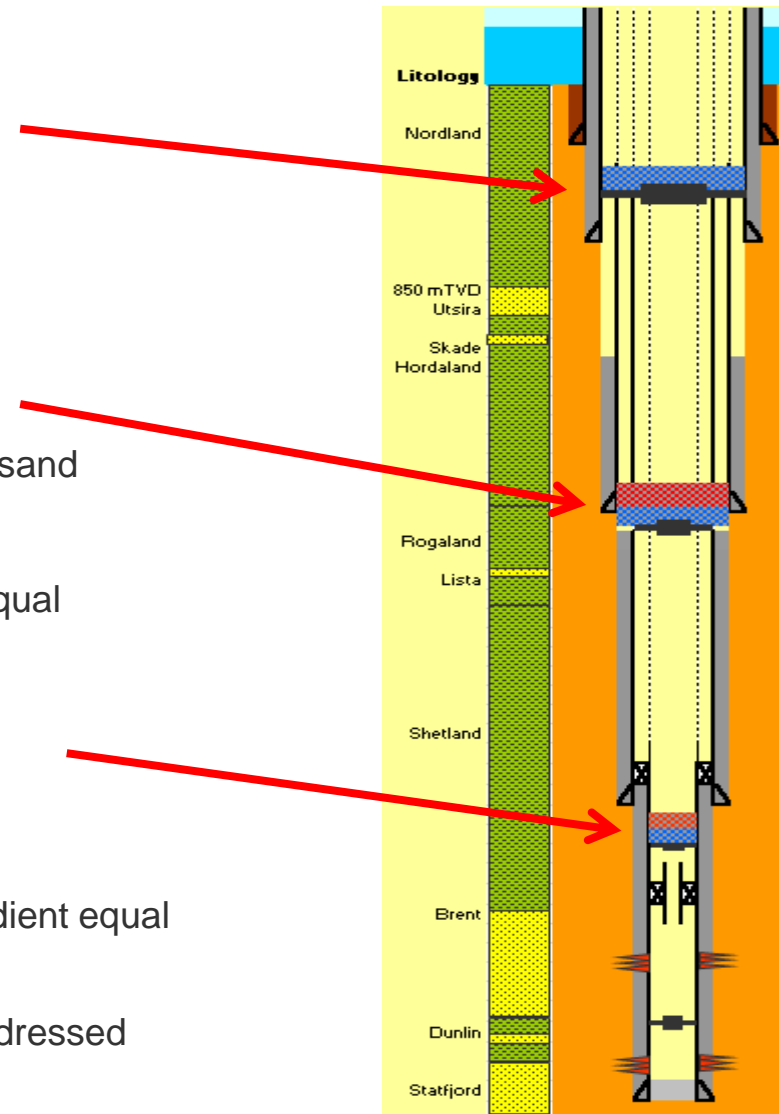
- No formation strength requirements
- Length 50 m plus mechanical base or else 100 m
- Placed as shallow as possible to cover shallow sands

Intermediate barrier

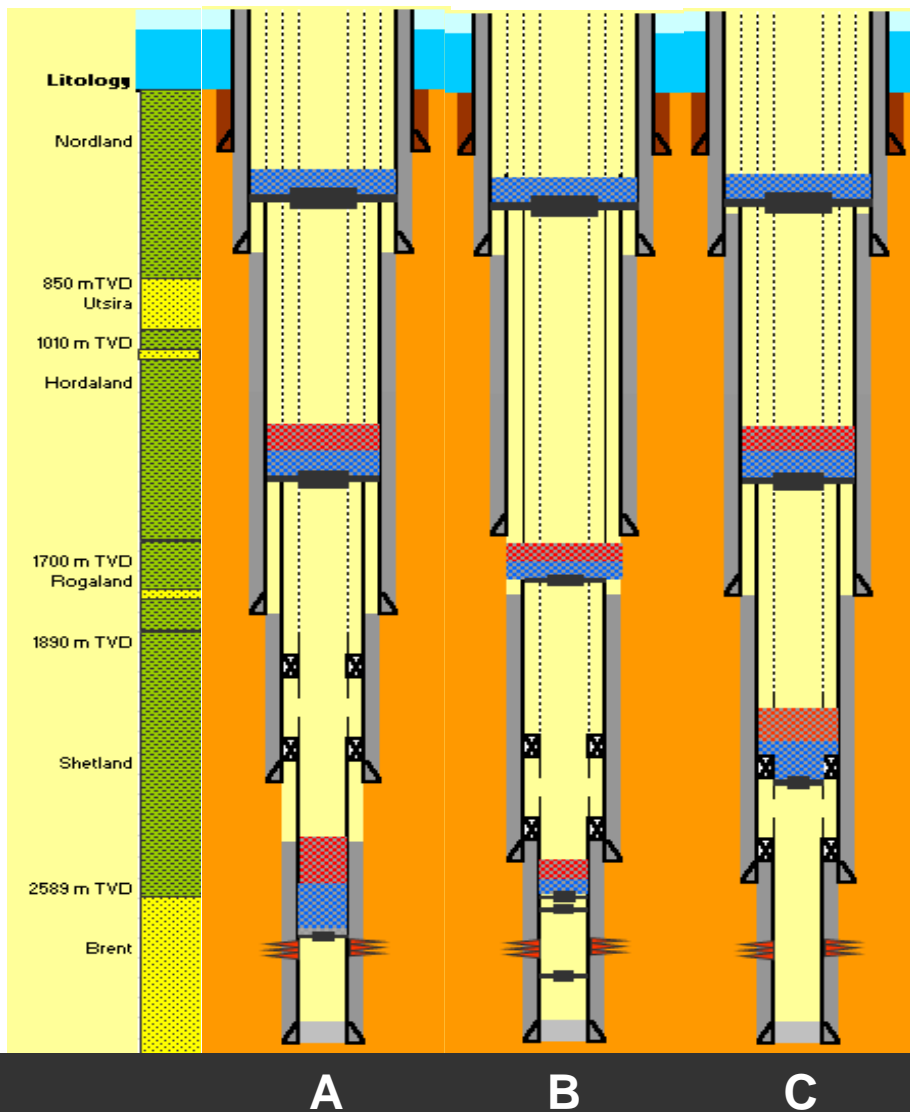
- Seal of documented inflow potential in Rogaland Gp. Lista Fm. sand
- Length 200 m or 2x 50 m plus mechanical base
- Depth minimum where Lista Fm pressure minus flux gradient equal minimum horizontal stress (Statoil requirement)

Reservoir barrier

- Seal of documented inflow reservoirs, Brent, Cook and Statfjord
- Length 200 m
- Depth minimum where initial reservoir pressure minus influx gradient equal minimum horizontal stress (Statoil requirement)
- Same pressure gradient through all reservoirs, cross flow not addressed



SFA PP&A Design Examples



A

- Reservoir barriers in 7» liner potentially set by coil tubing
- Intermediate barriers set in 13 3/8» after 9 5/8» retrieval
- Surface plug in 20» casing after some 13 3/8» retrieval

B

- Reservoir barriers in 7» liner potentially set by coil tubing
- Intermediate barriers set 9 5/8» and external job needed
- Surface plug in 20» casing after some 13 3/8» retrieval

C

- Reservoir barriers in 9 5/8» casing
- Intermediate barriers set in 13 3/8» after 9 5/8» retrieval
- Surface plug in 20» casing after some 13 3/8» retrieval

SFA PP&A Well Info example

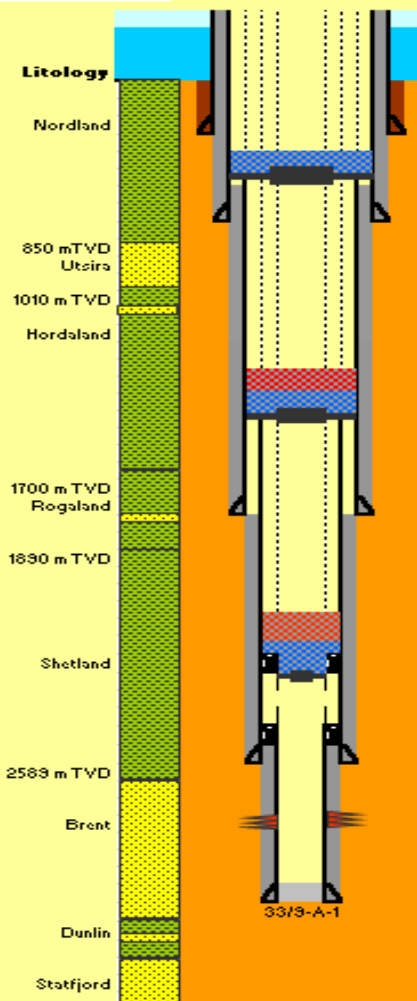


33/9-A-1

Sketch

Information

Comments



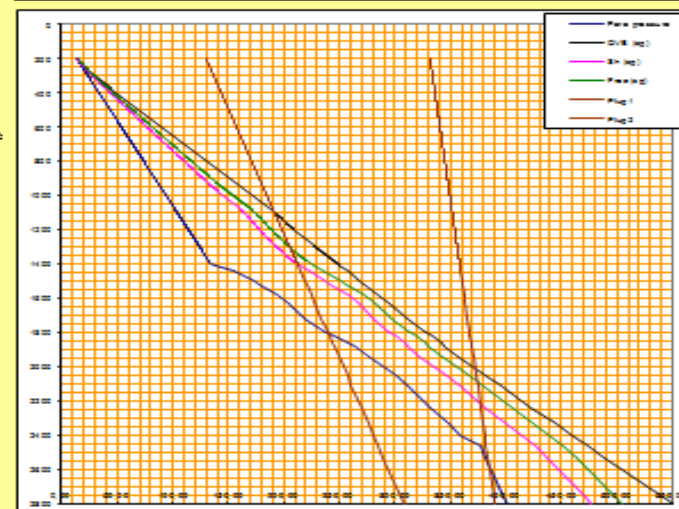
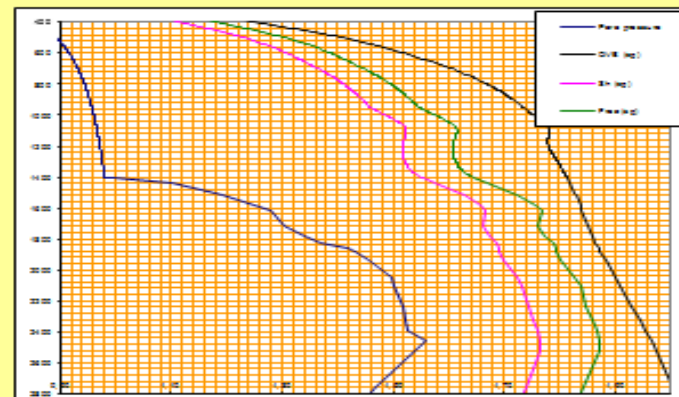
Pick plug below

2nd
1rst
mech



30"	mMD	mTYD	
	239	239	
Plug4	Base mMD	Top mMD	
	350	250	
20"	mMD	mTYD	
	528	528	
TOC	mMD	mTYD	*FWR
	378	378	
Plug3+4	Base mMD	Top mMD	
Plug Mec	1808	1608	
	1818		
13 3/8"	mMD	mTYD	
	2605	1834	
TOC	mMD	mTYD	CBL indicates TOC @ 2600. This is by the 13 3/8" shoe, and is not to be trusted. Based on calculations, and no losses during the cement job, TOC could be
	2600	1831	
Plug1+2	Base mMD	Top mMD	
Plug Mec	3411	3211	As done TOC was 3337 m.
	3421		
TOL	mMD	mTYD	
	3627	2367	
9 5/8"	mMD	mTYD	
	3833	2479	
Top Res	mMD	mTYD	
	4030	2583	
TOC	mMD	mTYD	Liner cement good below 3795 mMD / 2458 mTYD. (From CBL)
7"	3627	2367	

Pressure and gradient plots



Plug depth calculation

Input	
Future reservoir pressure	385 Bar
Depth to top reservoir/perf	2583 mTYD
Gradient of inflow fluid	0,227 sg

Intermediate plug

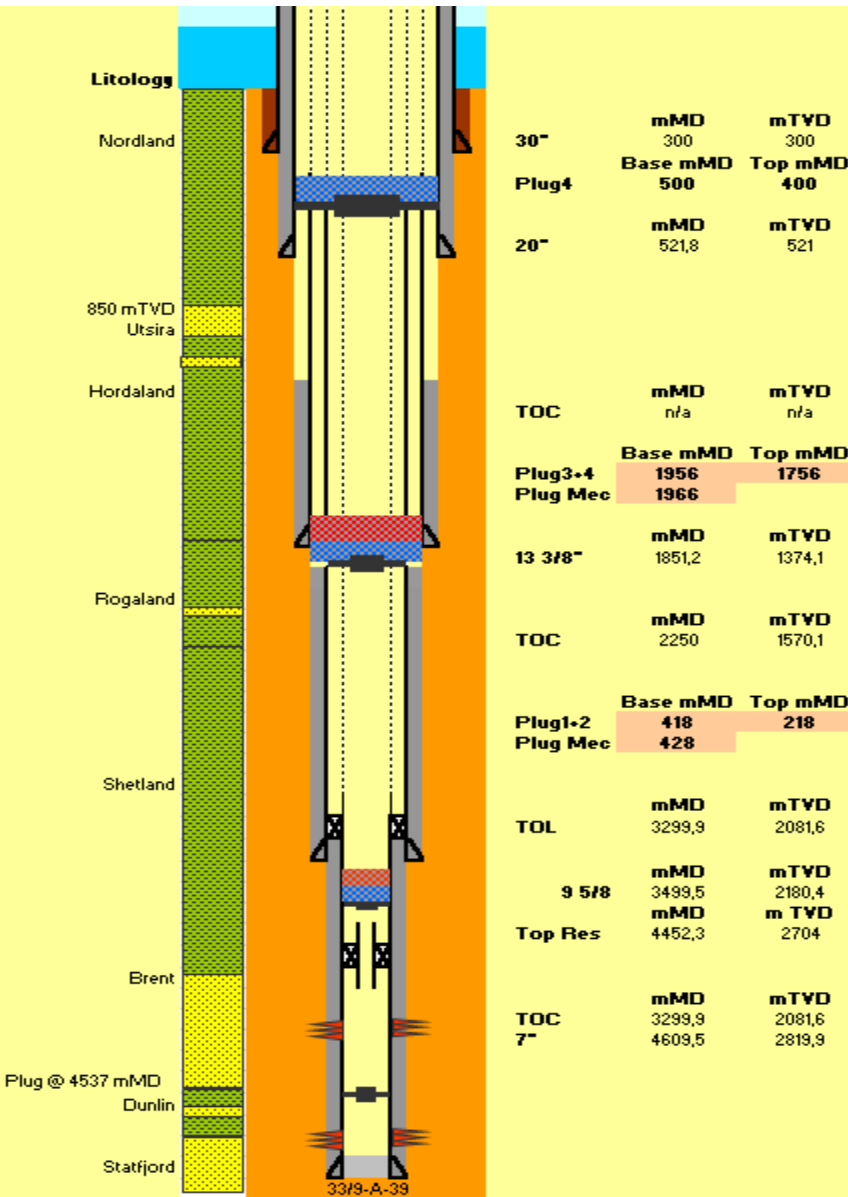
Pressure at inflow depth	240 Bar
Depth of inflow formation	1800 mTYD
Gradient of inflow fluid	0,7 sg

Output

			Maxwell MD/TVD
Depth of base plug	2207	mTYD	2200
Depth at base plug	3411	mMD	3297
Length of plug	200	mMD	
Depth at top plug	3211	mMD	3097

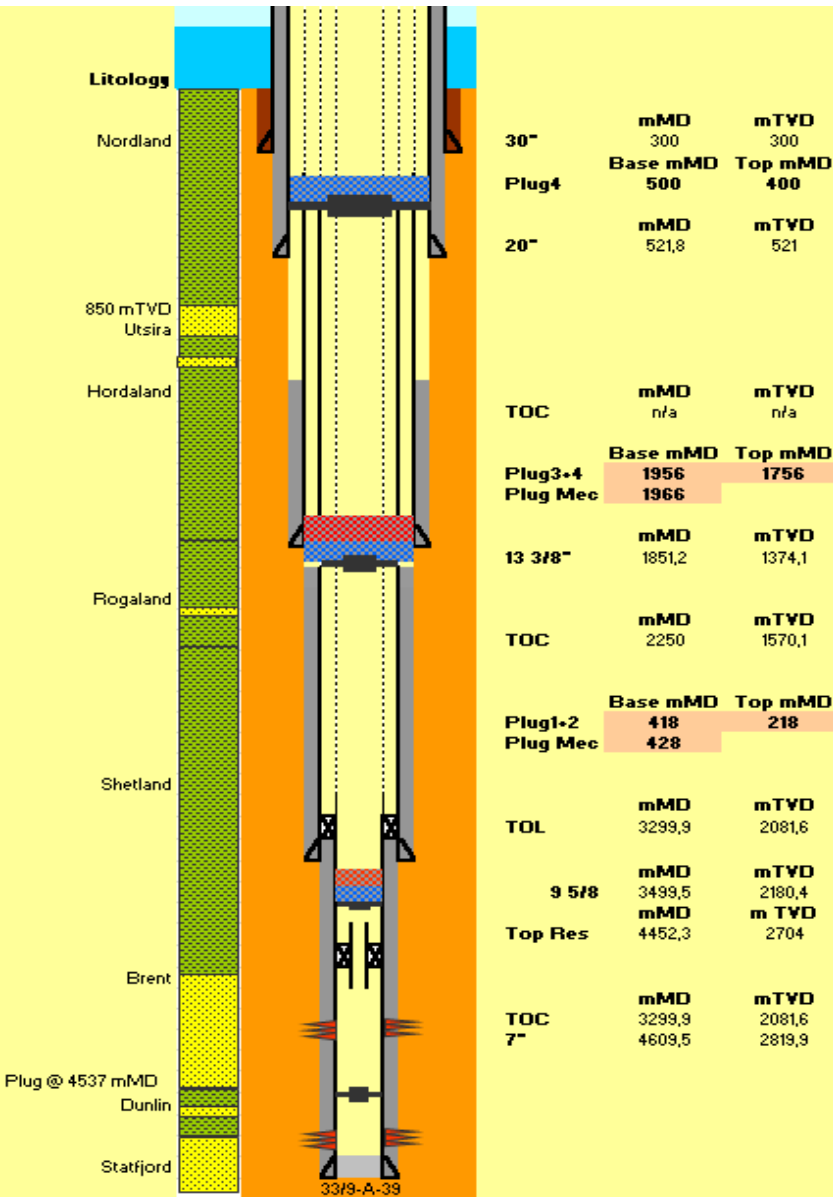
Depth of base plug	1377	mTYD	1410
Depth at base plug	1808	mMD	1769
Length of plug	200	mMD	
Depth at top plug	1608	mMD	1569

SFA PP&A Scope, schedule and cost (1)

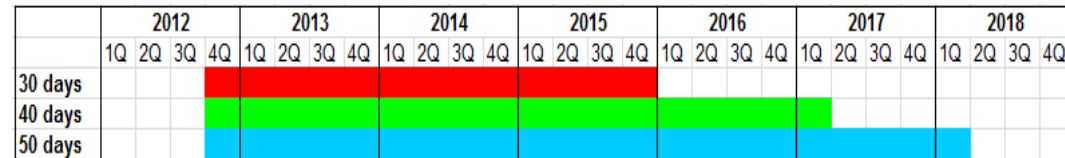


- Statfjord A has 40 wells and 2 installed unused conductors
- All wells need 2 barriers against reservoir (red+blue), 2 barriers against hydrocarbons in Rogaland Gp and one surface plug
- Internal barriers must be cement
- Getting access to set the cement plugs requires time consuming pulling of tubing and casing
- The scope takes 25-60 days in each well
- Most of the wells are now Brent producers but many was constructed as Statfjord producers.
- Earlier well paths was plugged by existing standards at the time. Old sketches and statuses are not yet collected. All wells have well integrity status green or yellow

SFA PP&A Scope, schedule and cost (2)



- The feasibility report for permanent P&A of the 42 SFA wells/slots was approved with a budget of approx. 1090 days and 1200 MNOK. (27.2 rig days per well)
- Budgets with concept, DG2, accuracy are approved for only two wells, A-1 and A-36. A-36 will over run this budget because the log of 13 3/8" revealed poor cement. A-1 will likely be finished within budget.
- A working budget is now 1600 days and 1760 MNOK as an unapproved concept budget.
- CoP is currently assumed to be 31.12.2016
- To finish PP&A within Q2 2017 one need to start Q3 2012 or latest Q1 2013.



SFA PP&A Cost saving potential

- The two main potential savers is “offline” work and methods like formation as barrier to reduce work establishing cross section by milling

Parameter	Rate	One Well		#Wells	Field Effect	
		Days	Cost		Days	Cost
Base case	1,1	40	44	40	1600	1760
CT set reservoir barrier		-8	0,5	16	-128	-8
Formation as reservoir barrier in Shetland		-14	15,4	3	-42	-46,2
Improved section milling for reservoir barrier		-8	8,8	3	-24	-26,4
Perforate, wash, squeeze method in Shetland		-8	8,8	3	-24	-26,4
Formation as barrier in Rogaland		-12	13,2	14	-168	-184,8
Perforate and squeeze method in Rogaland		-8	8,8	5	-40	-44
Improved section milling for Rogaland barrier		-8	8,8	2	-16	-17,6
Integrated Contract savings		0	1,6	40	0	-64
Optimum case with maximim time and cost saving					1158	1343
Difference					442	417

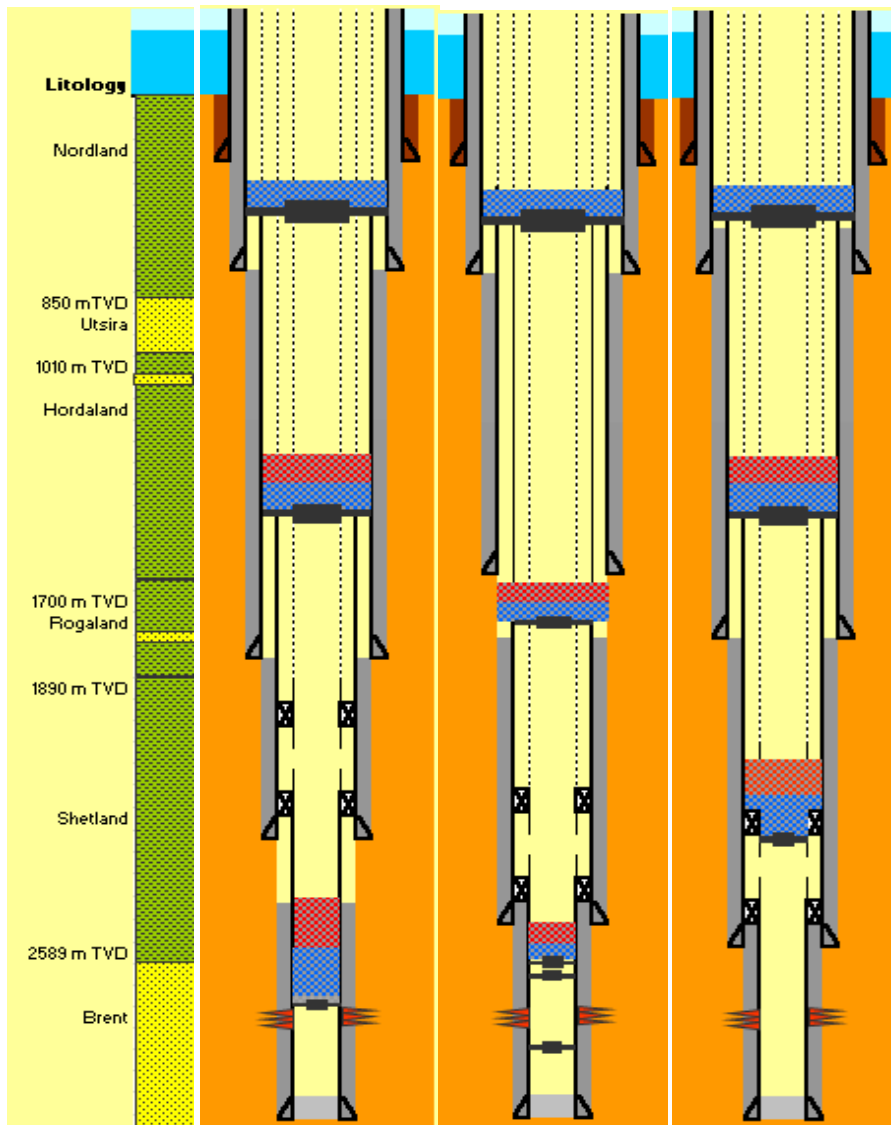
SFA PP&A – Cost risk focus points

Additional project focus points

- Cost increase after cease of production since D&W inflects prolonged cessation project time
- Adequately resourcing the planning of the P&A campaign is critical. This will minimize the number of rig days lost to down hole surprises and will reduce the risk of re-abandonments.
- Availability of platform resources will also have a large impact on P&A costs. The NPV impact of denying bed space to P&A crews (both rig and wire line) must be understood allocating this bed space to other users. Bed space is not currently a constraint.



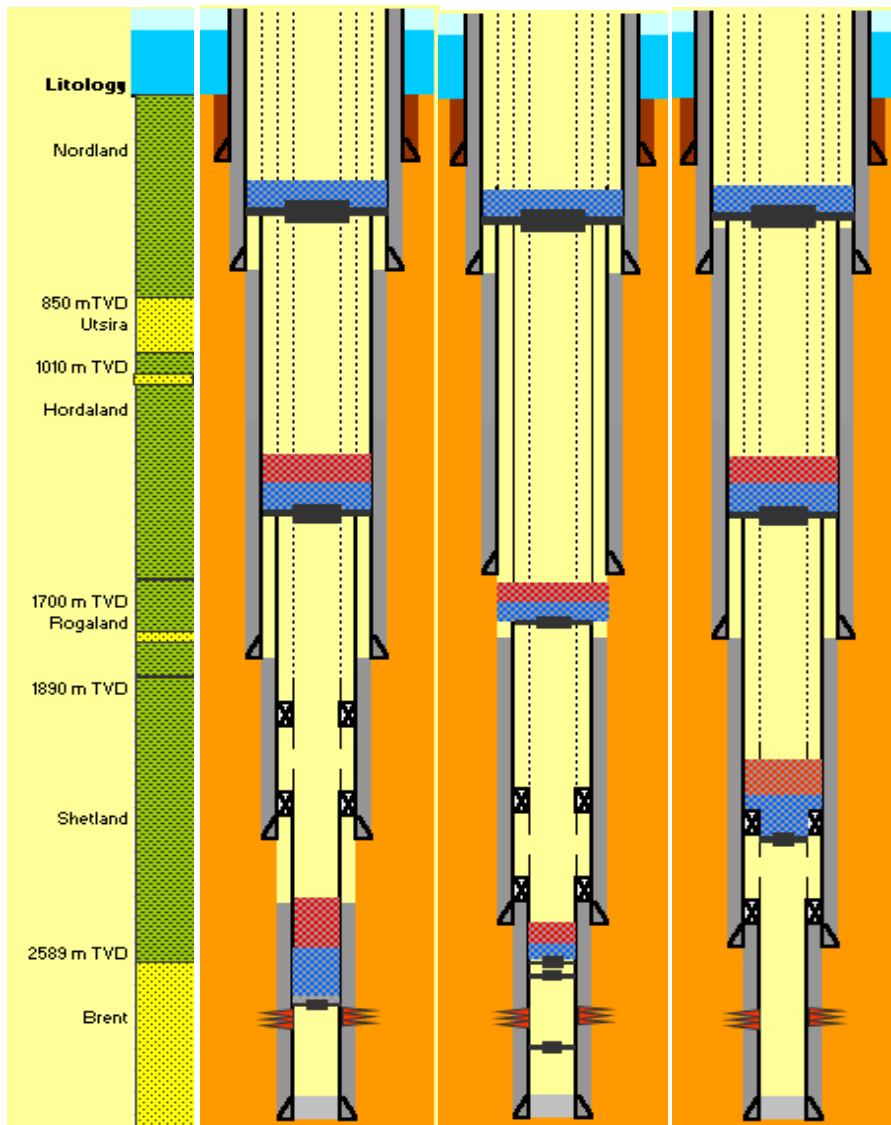
SFA PP&A designs and plan - Challenges



Challenges

- Cement logging -Lack of data.
 - Successful jobs does not log good
 - Logging tool show different result for same job when log is repeated
 - Scale hinders logging
 - Have to log through rig during P&A and plan for several outcomes
 - Risk of having to remedy external cement jobs in many wells – time consuming
 - Have to pull casing to get access to logging
- Uncertain end product for the conductors – depends on platform leg solution.
- NORSOK D-010 (2004) Issues.
 - “Inflow” not defined
 - “Eternal perspective” not defined
 - Planning according to NORSOK D-010 2004 when there is a 2012 version coming
- Reservoir re-charge difficult to estimate
- Difficult if internal requirements does not exactly match Norsok D-010

SFA PP&A designs and plan - opportunities



Opportunities

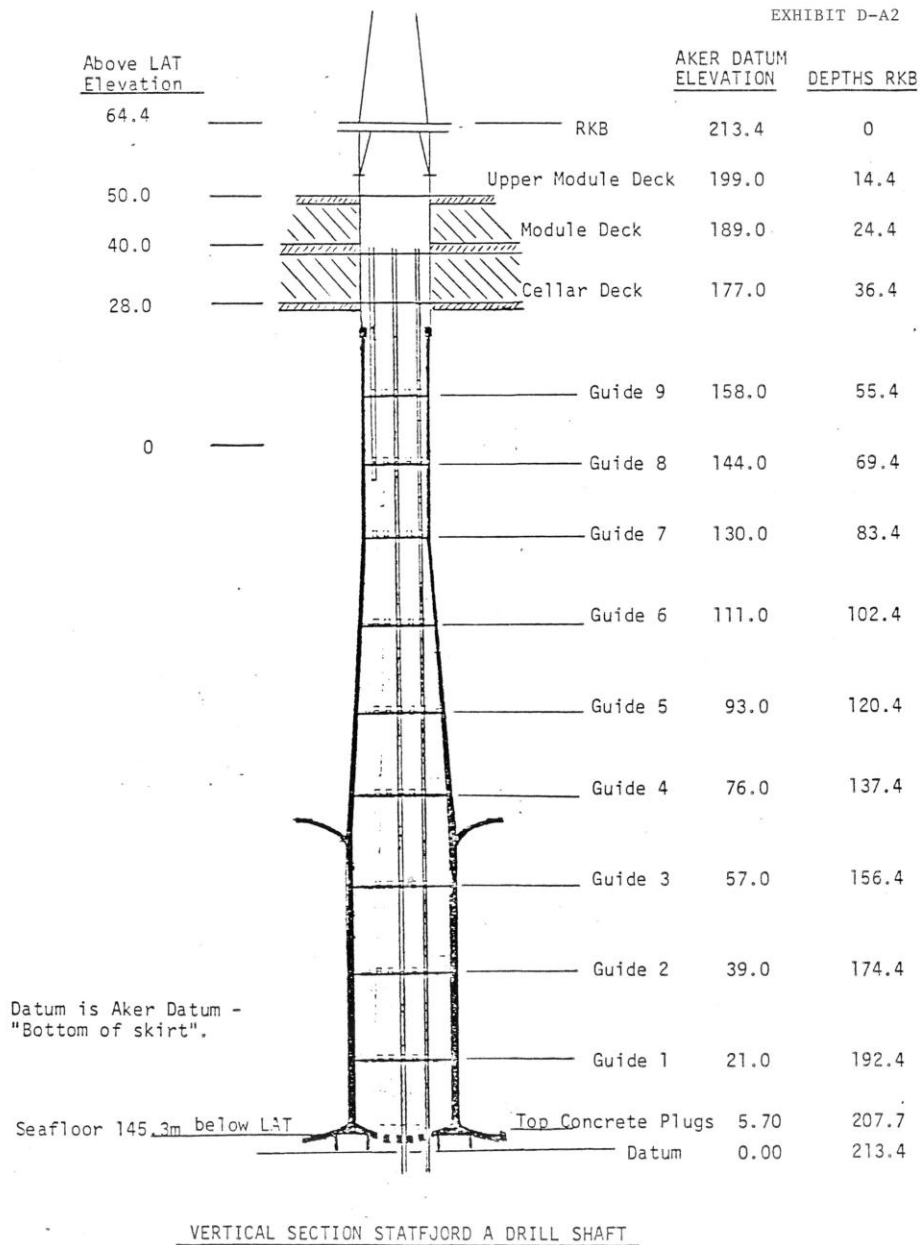
- Potential for stand alone work
 - Pumping, heavy fluid and cement
 - WL logging , plug setting, tubing punch and cut
 - Pull conductor, 20" and even 13 3/8" without drilling rig
- Good opportunity to do batch
 - Stand alone
 - Drill Shaft
 - BOP size
- External barrier materials
 - Formation, creep or collapse
 - Settled materials
 - Materials injected from surface
 - Combinations- cement , formation barite
- High RD priority in Statoil
- Emerging methods
 - Perforate, wash and cement
 - Milling without swarf to surface
 - 100 m in one run section mills

SFA PP&A – Current Status Overview

Green=6, black=6, orange=13, red=15

Barrier in...	Wells	# of	CT	1. ext	2. ext
7" + 13"	(A-36A), A-6AT2, A-15DT2, A-32B	4			
5" + 13"	A-38B	1			
7" + 9"	A-13B	1			
9" + 13"	(A-1), A-4, A-19, A-33B, A-20B, A-24B, A-34C	7			
9" + 9"	A-9, A-37C	2			
7" + ext 9"	A-14A, A-39, A-25AT3, A-42A, A-16BT4, A-12A, A-10 AT2, A-29AT2, A-41A, A-22AT2, A-40DT2	11			
5" + ext 9"	A-26BT2, A-28A	2	19		
9" + ext 9"	A-30AT2	1			
9" + ext 13"	A-3A, A-11AY2	2		31	
ext 5" + 13"	A-8C	1			
ext 7" + 13"	A-7C, A-17B	2			
ext 9" + 13"	A-23B	1			21
ext 7" + ext 9"	A-35 B, A-2B, A-18D, A-27C	4			
ext 7 + ext 13"	A-31AT2	1	21	9	19/5

SFA PP&A - Conductor one pager



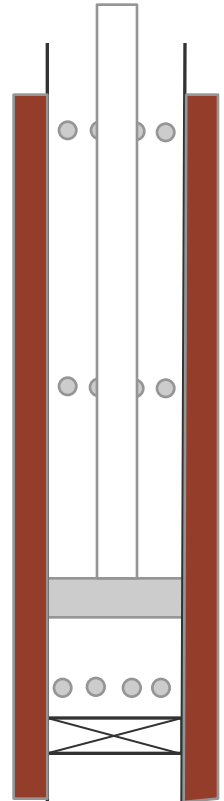
- A total of 42 30" conductors.
- Driven into 26" hole to approx. 300 mMD in 1977-78
- Shaft holds 11 guide/grid levels, access arrangements and piping.
- Shafts are sea water filled through under water connection/hatch.
- Drill cuttings fill to about 15 m above base
- Annulus between 30" and 20" filled with cement.
- Combined 30"+20"+cement weight 1124 kg/m.
- Weights: Sea bed 9000t, 55m below sea level 4500t, below leg top 1000t



SFA PP&A Game changer issues

Methods and requirements

- A Norsok D-010 definition of influx that excludes 0.x m thick and 0.044mD Lista fm. Sand as potential source (would still set plug but do no external fixes)
- Accepting tested annulus as barrier even if the annulus material is un-logged cement, settled material, formation or a combination of any
 - Why is not actually tested annulus better than just logged?
 - Test 50 m intervals between perforated sections
 - Should be considered for Norsok D-010 (2012 version)
- Find a way to pull pipe outside rig without violating automated pipe handling requirements.
 - How hands off do “automated” mean?
 - This is a extremely valuable option for pulling e.g. 13 3/8” if the well is plugged back into normally pressured formations, approx. 1400 mTVD as it can be at Statfjord



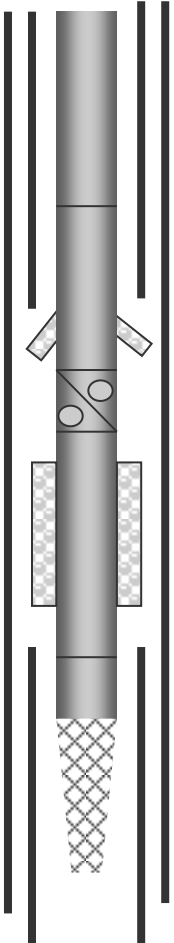
SFA PP&A Game changer issues

Technology

- Section mill that could do a 100 m in one run consistently, for 7", 9 5/8" and 13 3/8" without hole cleaning issues.
 - Now to many runs are needed
 - Swarf is a big issue, they either stay down hole or balls up.
- Cement log that really can be trusted
 - Result depend to much on log operator and log interpreter.
 - Costly decisions made on questionable background
 - Could there be an "annulus seal log" instead of a cement log?
- Anything that decrease rig scope and increase offline scope
 - Work with rig in parallel to speed up project or maintain production from producing wells

And all this I would liked dealt with within the end of 2012!

Cost saving potential, without increased risk, about 500 mNOK/30 % for SFA



Thank You