Eider Alpha Well P&A

Appraise vs Execute

Agenda

- **P&A Planned vs Actual**
  - High Level Operational Plan
  - Project Schedule ‘Rig Based’ – Aug 2017
  - Project Schedule ‘Rig Based’ - Actual
- **AP1 Campaign Breakdown**
  - Simple Rigless Overview
  - Simple Rig Work Overview
  - Complex Rig Work Overview
  - Methodology Summary
- **P&A Planned vs Actual - Reflection**
  - Well Complexity
  - Well Timing to Complexity
- **Phase 1 Selection Methodology - Hindsight**

Eider Alpha Platform

- Discovered in 1976 and began producing oil in 1988
- Peak production 41,000 bpd
- In Jan 2017 production was:
  - 1,000-1500 bpd from Eider
  - 2,000-4000 bpd from Otter
- Last drilling operations performed on platform in 1998

Eider Abandonments Strategy

- **Strategy** - The objective of the project was to develop a well abandonment strategy for Eider to minimise the time and cost and achieve assembly line efficiency in gaining platform hydrocarbon free status.

- '**Highest Value**' strategy selected - Maintains production throughout abandonments

1. Permits flexibility to maintain production should the economic climate change
2. Prolongs the Eider revenue stream to help fund the ABEX expenditure
3. Abandons the low value wells as a priority reducing OPEX exposure

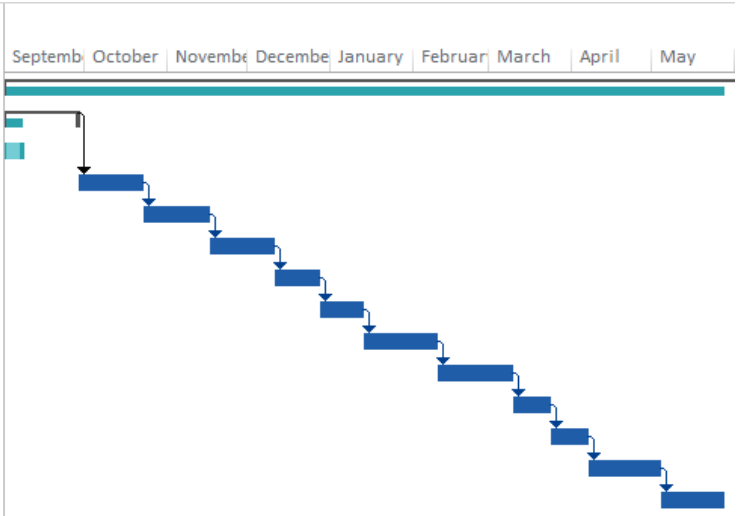
Planned vs Actual – High Level Sequence

Eider Abandonment Campaign Sequence

- 2013 – Independent review and classification of well abandonment methodology for ARO (Asset Retirement Obligation) estimate
- 2015 – Initial Planning of 'low contributor' wells
- Q3 2016 - Upfront Wireline & Investigation
- Q1/Q2 2017 - Campaign 1 – Rigless abandonment via cement bullheading
- Q2 2017 - Campaign 2 – Rigless abandonment via coiled tubing
  - Cancelled due to lack of economical viability (1 well, moved to rig-based)
- Q3 2017 - Campaign 3 – Rig-Based abandonment
  - Simple rig based - 'low hanging fruit'
  - CEL & rigless bullheading - high value wells
  - Simple rig based – high value wells
  - Section milling
  - CRI well(s) abandonment

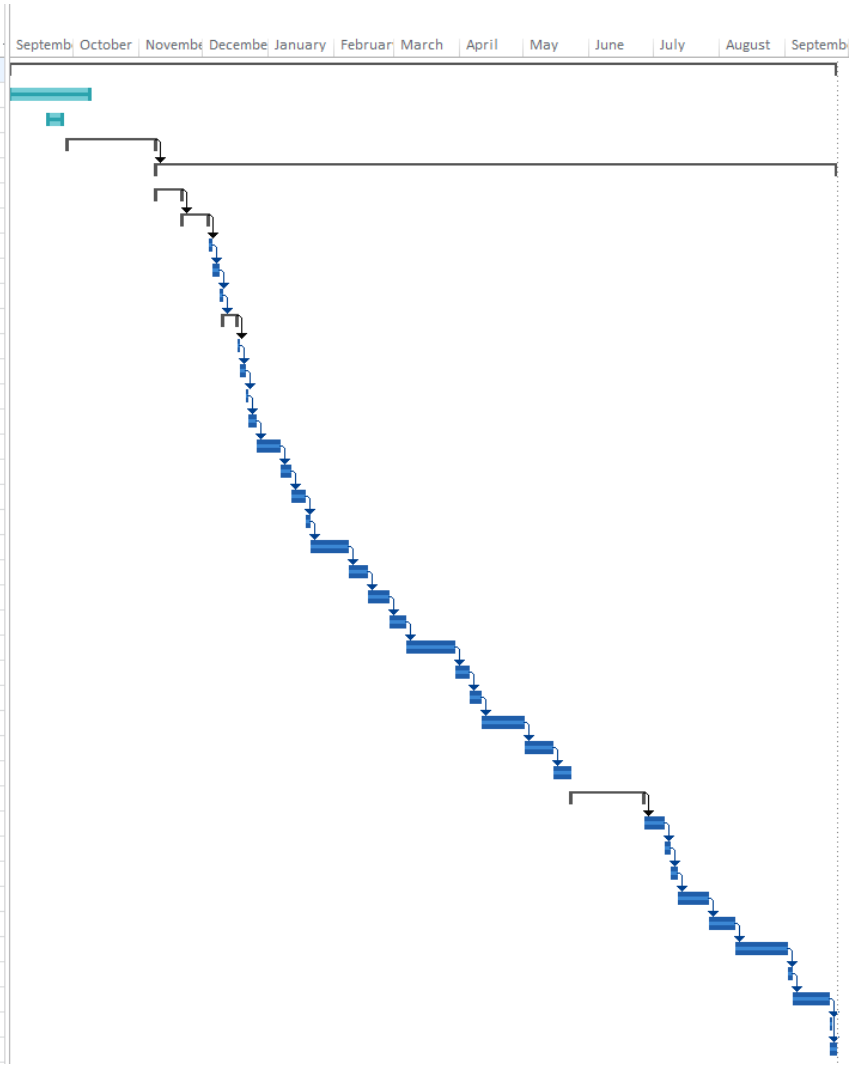
Eider Project Schedule – Rig Based (Aug 2017)

Task Name	Duratio	Start	Finish	Predec
Campaign 3 -Rig based wells (2,7,4,3,5,13,16,21,22,8,15)	**675 days?**	**Fri 01/09/17**	**Sun 07/07/19**	
Crew mobilisation / familiarisation	**28 days**	**Fri 01/09/17**	**Thu 28/09/17**	
Install CRI equipment and test	7 days	Fri 01/09/17	Thu 07/09/17	
EA22 (WI)- Drillpipe as a cement stinger + Env plug	24 days	Fri 29/09/17	Sun 22/10/17	230
EA21 (WI)- Drillpipe as a cement stinger + Env plug	25 days	Mon 23/10/17	Thu 16/11/17	232
EA18 (WI) - Drillpipe as a cement stinger + Env Plug	24 days	Fri 17/11/17	Sun 10/12/17	233
EA05 (P) - Tubing as a cement stinger + Env plug	17 days	Mon 11/12/17	Wed 27/12/17	234
EA04 (P) - Tubing as a cement stinger + Env plug	16 days	Thu 28/12/17	Fri 12/01/18	235
EA02 (WI) - Remedial work + Env plug	28 days	Sat 13/01/18	Fri 09/02/18	236
EA03 (WI) - Remedial work + Env plug	28 days	Sat 10/02/18	Fri 09/03/18	237
EA08 (P) - Bullhead + Env plug	14 days	Sat 10/03/18	Fri 23/03/18	238
EA15(P) - Bullhead + Env plug	14 days	Sat 24/03/18	Fri 06/04/18	239
EA16 (P) - Remedial work + Env plug	27 days	Sat 07/04/18	Thu 03/05/18	240
EA13 (P) - Drillpipe as a cement stinger + Env plug	24 days	Fri 04/05/18	Sun 27/05/18	241

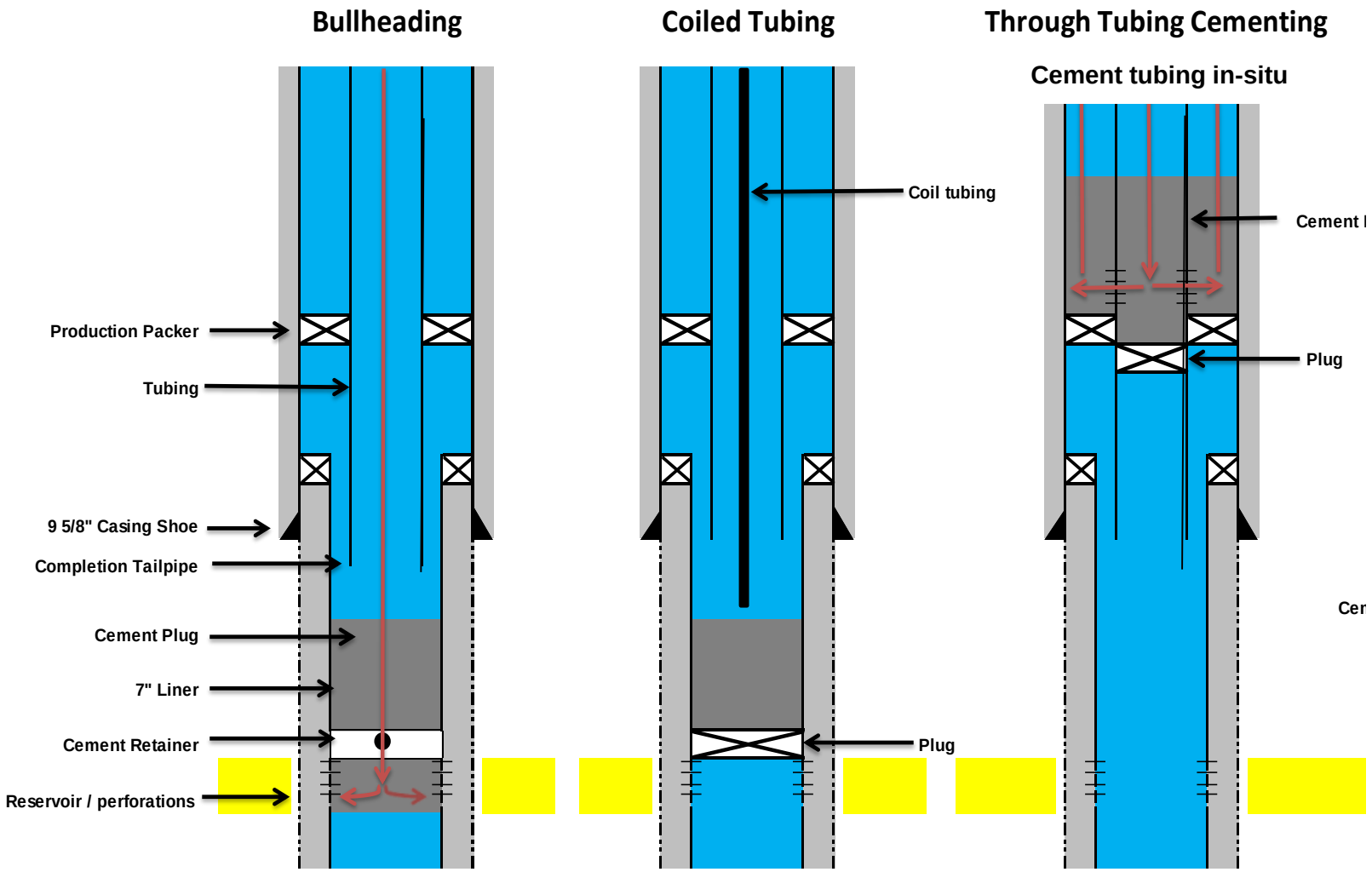


Eider Project Schedule – As completed Sept 2018

Task Name	Duration	Start	Finish
Campaign 3 -Rig based wells	**389.5 days**	**Fri 01/09/17**	**Tue 25/09/18**
Drill Crew Mobilisation / Familiarisation	38 days	Fri 01/09/17	Sun 08/10/17
Install CRI equipment and test	7 days	Tue 19/09/17	Mon 25/09/17
Well Intervention - EA22, EA21 & EA18 (contingent)	**42 days**	**Thu 28/09/17**	**Wed 08/11/17**
Rig Based Abandonment	**320.5 days**	**Thu 09/11/17**	**Tue 25/09/18**
EA22 (WI) - Drillpipe as a cement stinger	**12.35 days**	**Thu 09/11/17**	**Tue 21/11/17**
EA18 (WI) - Drillpipe as a cement stinger	**12.2 days**	**Tue 21/11/17**	**Sun 03/12/17**
EA10 - Tree Removal + Pull cmpl	2.25 days	Sun 03/12/17	Tue 05/12/17
EA19 - Pull Tubing	2.75 days	Tue 05/12/17	Fri 08/12/17
WOW & deck management	2 days	Fri 08/12/17	Sun 10/12/17
EA21 (WI) - Drillpipe as a cement stinger	**6.5 days**	**Sun 10/12/17**	**Sun 17/12/17**
EA05 (P) - Tubing as a cement stinger - operation suspended	1.5 days	Sun 17/12/17	Mon 18/12/17
EA02 Shallow Set Plug	2.5 days	Mon 18/12/17	Thu 21/12/17
EA09 Shallow Set Plug & Investigation	1.5 days	Thu 21/12/17	Fri 22/12/17
EA05 (P) - Revisit -Tubing as a cement stinger - operation suspended	3.5 days	Fri 22/12/17	Tue 26/12/17
EA04 (P) - Tubing as a cement stinger	11 days	Tue 26/12/17	Sat 06/01/18
EA08 (P) - Wireline (through Rig) Set deep & shallow plugs	5 days	Sat 06/01/18	Thu 11/01/18
EA15(P) - Wireline (through Rig) & Bullhead	7.5 days	Thu 11/01/18	Thu 18/01/18
CRI Injection Trials EA13 & EA03	2 days	Thu 18/01/18	Sat 20/01/18
EA05 - Revisit 2 - Kill Well, Pull Tubing & 9 5/8" EZSV/Cement	17.5 days	Sat 20/01/18	Wed 07/02/18
EA02 (WI) - Tubing removal, RTTS set and Suspension Flange	9 days	Wed 07/02/18	Fri 16/02/18
EA02 (WI) - 9 5/8" Removal & Drill Pipe as cement stinger	10.4 days	Fri 16/02/18	Mon 26/02/18
EA08 - Drillpipe as cement stinger & B annulus AP2 scope	8.5 days	Mon 26/02/18	Tue 06/03/18
EA14 - 9 5/8" Removal, Drill Pipe as Cement Stinger	23 days	Tue 06/03/18	Thu 29/03/18
6 monthly Derrick Inspection & Critical Maintenance	7 days	Thu 29/03/18	Thu 05/04/18
EA14 - AP1 Verification. AP2 Operations Suspended	5.25 days	Thu 05/04/18	Wed 11/04/18
EA01 - Cement Stinger on DP Remedial Work	20 days	Wed 11/04/18	Tue 01/05/18
EA09 - Cement Stinger on DP Remedial Work (operations suspended)	13.6 days	Tue 01/05/18	Mon 14/05/18
EA16 - Tubing removal, 9 5/8" Log RTTS set and Suspension Flange	9 days	Mon 14/05/18	Wed 23/05/18
Various Wells AP2 only operations	**34.2 days**	**Wed 23/05/18**	**Tue 26/06/18**
EA15 - Drillpipe as cement stinger, 9 5/8" B Annulus isolation	9.5 days	Wed 27/06/18	Fri 06/07/18
EA19 - 9 5/8" Removal	2.5 days	Fri 06/07/18	Sun 08/07/18
Equipment Set up & Prepartion for Section Milling	3.5 days	Mon 09/07/18	Thu 12/07/18
EA16 (P) - Section Milling	14.5 days	Thu 12/07/18	Thu 26/07/18
EA09 - Section Milling 13 3/8"	12.5 days	Fri 27/07/18	Wed 08/08/18
EA03 (WI) - Section Milling 9 5/8"	25 days	Wed 08/08/18	Sun 02/09/18
EA04 -AP2 scope - B Annulus Isoaltion	2 days	Sun 02/09/18	Tue 04/09/18
EA13 (P) - Drillpipe as a cement stinger	17.5 days	Tue 04/09/18	Fri 21/09/18
EA14 - RTTS Removal, 13 3/8" EZSV set	1 day	Sat 22/09/18	Sat 22/09/18
EA16 - 9 5/8" EZSV, 9 5/8" Cut & Recover	3.5 days	Sat 22/09/18	Tue 25/09/18



Abandonment Methods - Rigless



AP1 – Simple Rigless Overview

Total = 31.4 days including rig activity for successful wells

52.8 days pure rigless activity - including failed wells

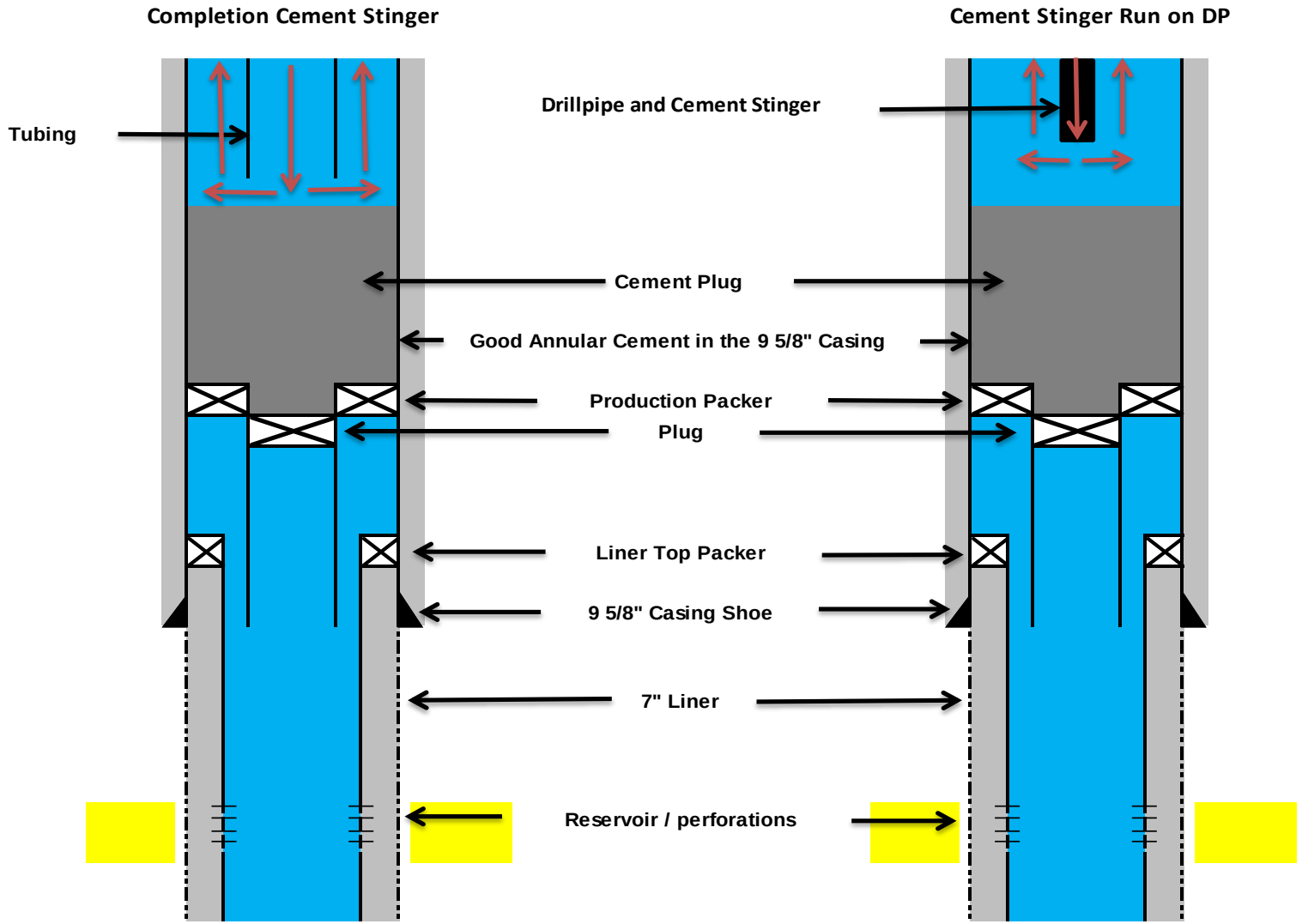
Total of 7 wells were attempted using bullheaded cement.

- 3 wells were successfully verified
  - 1 of which successfully trialled agitator tool
- 1 well failure believed to be previous sidetrack
- 2 well failures did not have cement retainers
  - 1 well failure found to have strung out cement

Challenges / Lessons Learned

- Shallow cut of tubing on failed wells incurred unplanned fishing time – particularly where cement was strung out – ***up to 4.5 days NPT***
- Monitoring period extended due to potential seasonal temperature interference.
- **Where method was successful it saved circa 22 rig days average**

Abandonment Methods – Rig-based



AP1 – Simple Rig-Based Overview

Planned – 27.5 days/well

Average 17.1 days per well (normalised)

Total of 14 wells were reviewed for abandoning via simple rig-based.

- 8 wells were found to have sufficient cement behind 9 5/8”
- 7 wells were abandoned using drill pipe as a cement stinger
- 1 well was abandoned using tubing as cement stinger (tubing left in hole after) - **Time saving <1 day – negated by scrap value of tubing**

Challenges / Lessons Learned

- 1/3 of wells found to part at PBR during completion pull
- Use of “pump thru” shallow set plugs saved rig time
- Difficulties running logging tools in high ppg WBM – circulated out to seawater

AP1 – Complex Rig-Based Overview – 13 3/8”

Not planned (alternative contingent to section milling @ 40 days/well)

Average – 22 days/well (normalised)

Total of 4 wells were reviewed for abandoning across the 13 3/8” casing

- 3 wells were found to have sufficient cement behind 13 3/8”

Challenges / Lessons Learned

- 50% of 9 5/8” deep cuts were initially unsuccessful inducing multiple cut & pull runs
- Casing ‘ovaling’ and increased friction on pulling circa 4500ft – 6100ft
  - Thick clay found on outside of 9 5/8”
- Heavy amounts of debris found behind 9 5/8” preventing adequate circulating / inducing swabbing on pulling
- Improved operations through learnings resulted in decrease in cut & pull time by >50%
- **Where method was successful it saved on average 3 rig days compared to section milling 9 5/8”**

AP1 – Complex Rig-Based Overview – Section Milling

Planned – 40 days /well

Average – 25 days/well (normalised)

Total of 3 wells required section milling to obtain an AP1 isolation

- 2 wells were section milled across 9 5/8”
  - 2 runs were required for both
- 1 well was section milled across 13 3/8”
  - Sufficient length of milling obtained in 1 run

Challenges / Lessons Learned

- Difficulties keeping a ‘clean hole’ due to insufficient annular velocity in 9 5/8”
- **When operations were optimised, difference between total time for 9 5/8” vs 13 3/8” was negligible.**

Planned vs Actual – Well Complexity

Eider Alpha P&A ARO			ESTIMATED ABANDONMENT COMPLEXITY				
			Type 0 No work required	Type 1 Simple Rig-less	Type 2 Complex Rig-less	Type 3 Simple Rig-based	Type 4 Complex Rig-based
PHASE	1	RESERVOIR ABANDONMENT	1	9	2	4	2
	2	INTERMEDIATE ABANDONMENT	0	18	0	0	0
	3	WELLHEAD / CONDUCTOR REMOVAL	0	0	2	15	1

Eider Alpha P&A ACTUAL			ACTUAL ABANDONMENT COMPLEXITY				
			Type 0 No work required	Type 1 Simple Rig-less	Type 2 Complex Rig-less	Type 3 Simple Rig-based	Type 4 Complex Rig-based
PHASE	1	RESERVOIR ABANDONMENT	1	**3**	0	**10**	**4**
	2	INTERMEDIATE ABANDONMENT	0	0	0	**10**	**8**
	3	WELLHEAD / CONDUCTOR REMOVAL	0	0	0	18	0

Phase 1 Rigless scope decreased from 11 operations to 7 of which only 3 were successful

- Change in well integrity status
- Insufficient liner cement

ARO Phase 2 complexity did not account for X-Mas Tree & completion removal from Phase 1 Rigless activities

Planned vs Average Duration to Well Complexity

Eider Alpha P&A ARO			ESTIMATED DAYS PER WELL				
			Type 0 No work required	Type 1 Simple Rig-less	Type 2 Complex Rig-less	Type 3 Simple Rig-based	Type 4 Complex Rig-based
PHASE	1	RESERVOIR ABANDONMENT	0	7.45	16.6	27.51	39.97
	2	INTERMEDIATE ABANDONMENT	0	2.4	7	12.6	31.74
	3	WELLHEAD / CONDUCTOR REMOVAL	0	2.94	2.96	4.99	6

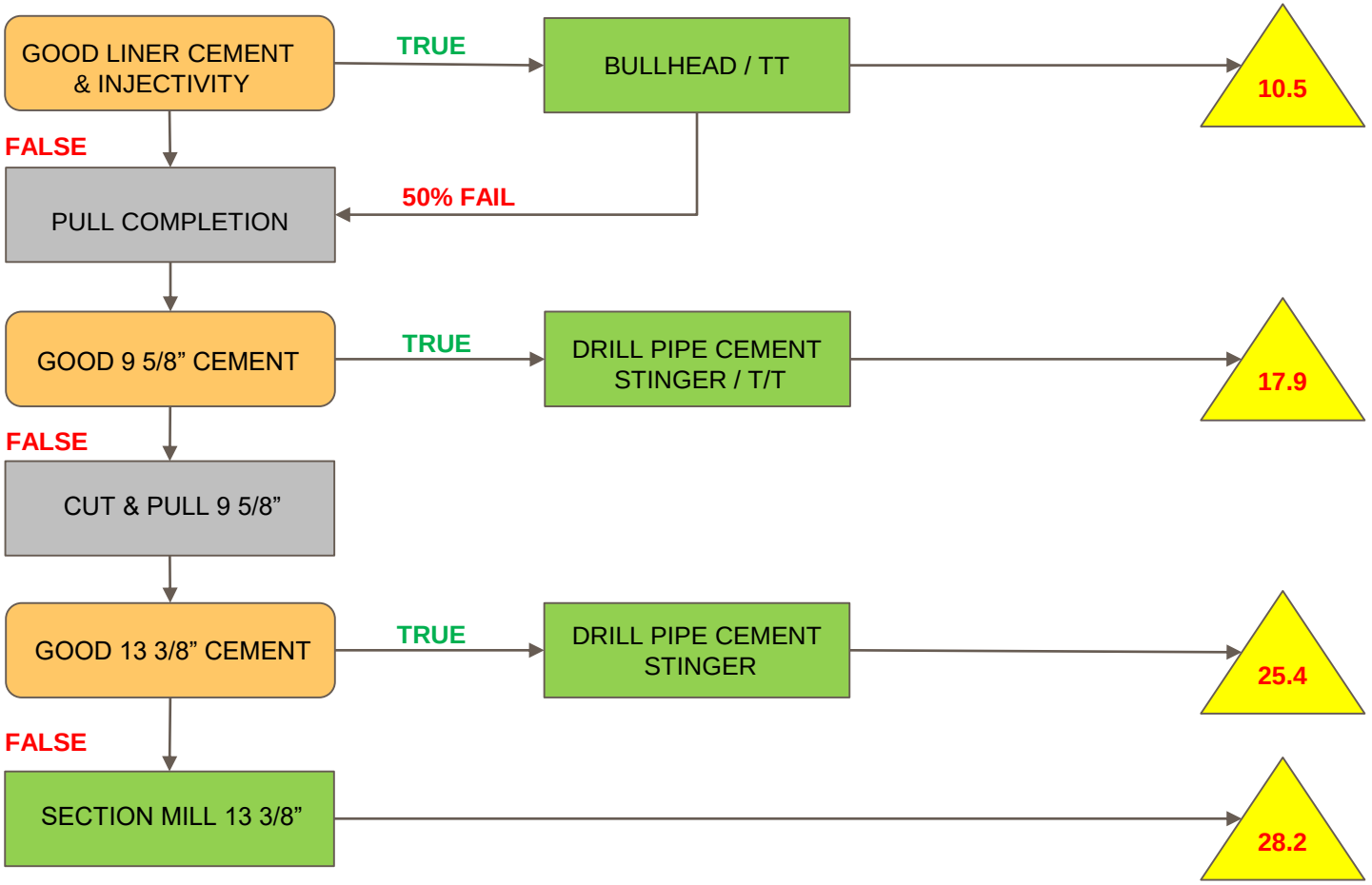
Eider Alpha P&A ACTUAL			AVERAGE ACTUAL DAYS PER WELL				
			Type 0 No work required	Type 1 Simple Rig-less	Type 2 Complex Rig-less	Type 3 Simple Rig-based	Type 4 Complex Rig-based
PHASE	1	RESERVOIR ABANDONMENT	0	**7.55**	0	**17.18**	**23.05**
	2	INTERMEDIATE ABANDONMENT	0	0	0	**4.96**	**9.8**
	3	WELLHEAD / CONDUCTOR REMOVAL	0	0	0	**2.55**	0

ARO 420 days v Actual 495 days

- Rig based average timings significantly less than anticipated
- ALL Phase 2 & 3 operations were conducted using Rig Based operations (Simple & Complex)

Phase 1 Abandonment Selection Methodology

Eider 'Hindsight' Flow Chart



SUMMARY

Campaign Optimisation

- Multi disciplinary teams greatly aided ‘out of the box’ thinking ensuring challenges from well conditions were addressed efficiently and safely
- Reviewing operational sequence against weather forecasts minimised weather related NPT (only 3%)
- Collaborative approach with service companies promoting multi disciplined services minimised POB and enhanced ownership throughout the team

Reflection to Strategy

- **Strategy** - The objective of the project was to develop a well abandonment strategy for Eider to minimise the time and cost and achieve ~~assembly line~~ **flexible operational** efficiency in gaining platform hydrocarbon free status *whilst maintaining a first class safety culture.*


TAQA