Air injection and displacement for recovery with oil horizontal (AIDROH) project Approval #11618 Performance presentation

Alberta Energy Regulator offices

Calgary

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cenovus ENERGY

Advisory

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AIDROH* introduction and overview

This presentation was prepared in accordance with AER Directive 054 - Performance presentations, auditing, and surveillance of in situ oil sands schemes

Subsurface issues related to resource evaluation and recovery

- Directive 054, Section 3.1.1

Surface operations, compliance, and issues not related to resource evaluation and recovery

- Directive 054, Section 3.1.2

* Canadian patent CA2594413

AER Dir 054 Section 3.1.1

Subsurface issues related to resource evaluation and recovery

Subsurface issues: Table of contents

- Scheme background
- Geology/geoscience
- Drilling and completion
- Artificial lift
- Instrumentation
- Scheme performance
- Future plans

Scheme background

Subsurface section 1

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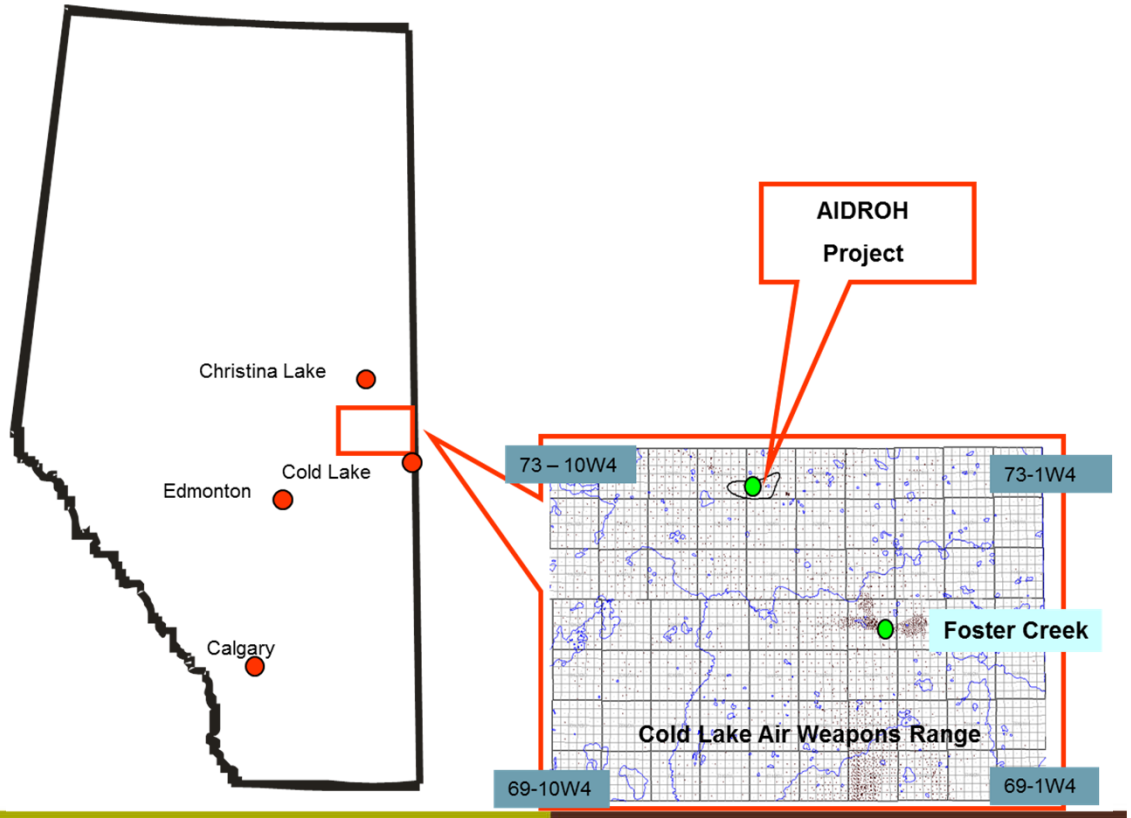
Background

The AIDROH project uses gravity drainage as a bitumen recovery process to recover bitumen that has been passively heated by the Cenovus EnCAID combustion project

Location map



Geological/geoscience

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Subsurface section 2

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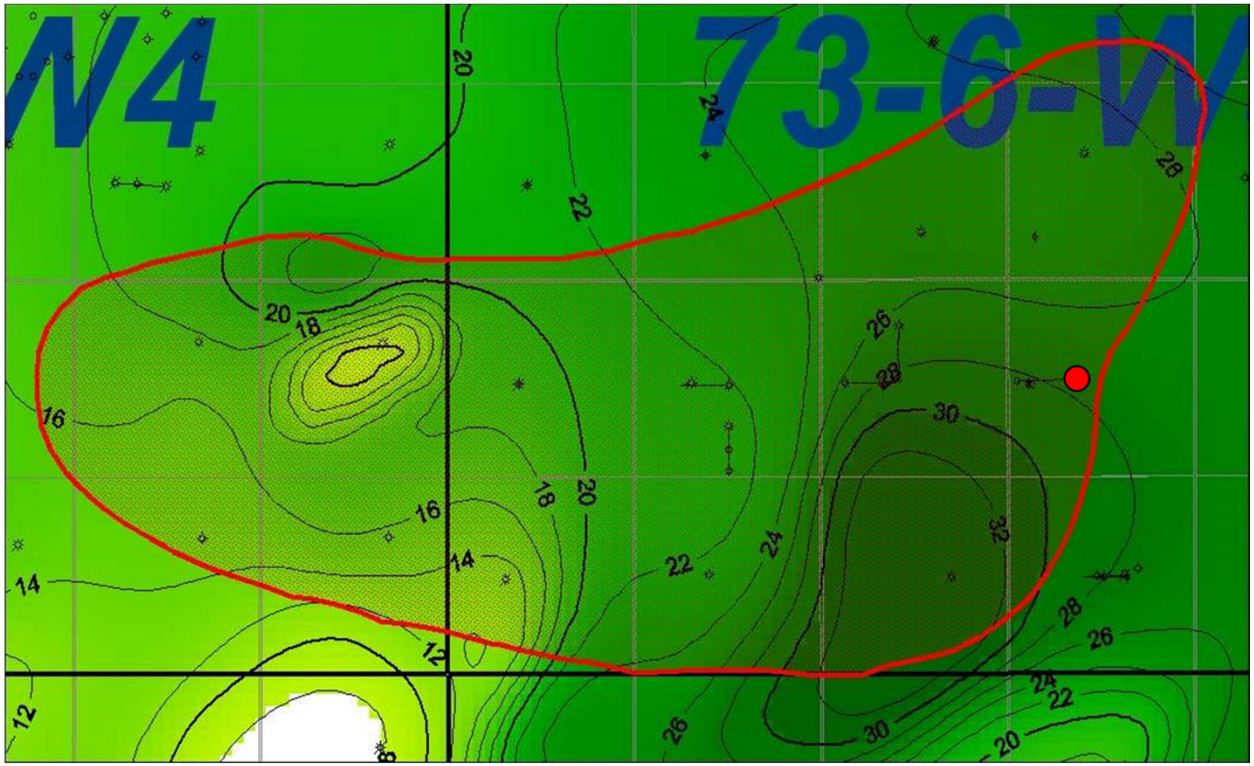
Summary of reservoir properties

Depth	465m TVD
Thickness	25-30m
Average porosity	35%
Average bitumen saturation	65%
Average permeability	1,350mD
OBIP (project area)	3,302 e^3m^3
Oil viscosity @ 13C @ 60C	~25,000 cP ~600 cP
API oil gravity	10.3 - 10.8

Wabiskaw bitumen thickness



Type log cut offs:-
-<75 api gamma ray
->20 ohm resistivity
->27% porosity

OBIP under gas cap = 159,000 e³m³

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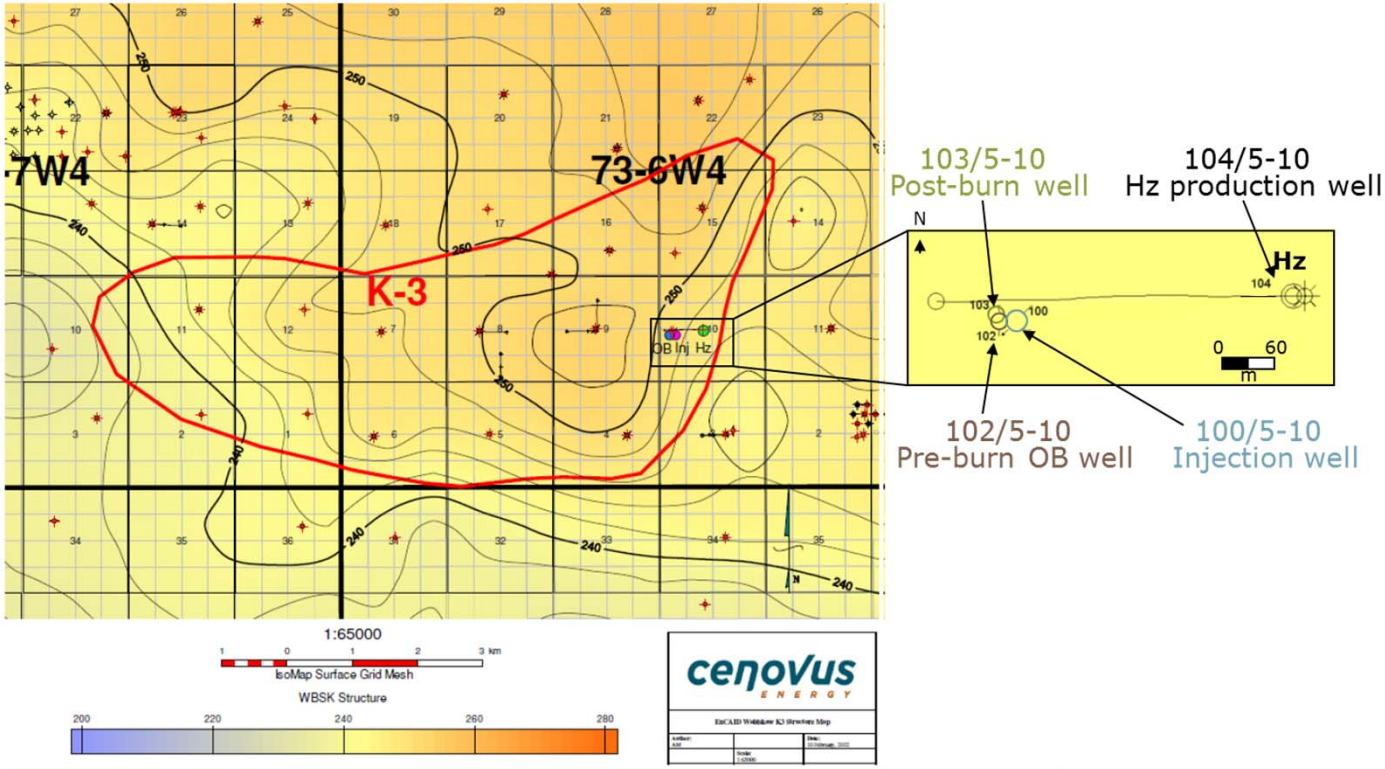
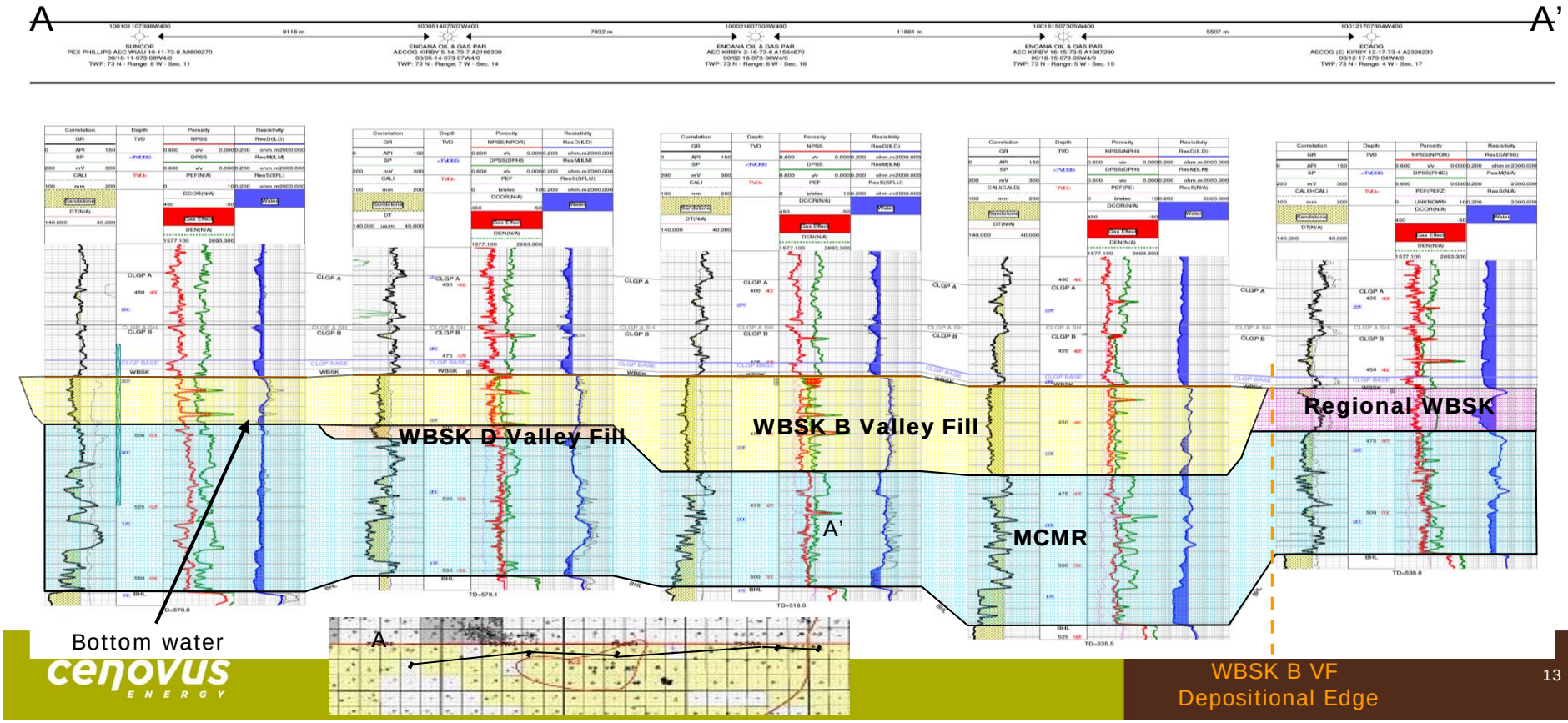
Wabiskaw structural map



Wabiskaw stratigraphic cross-section



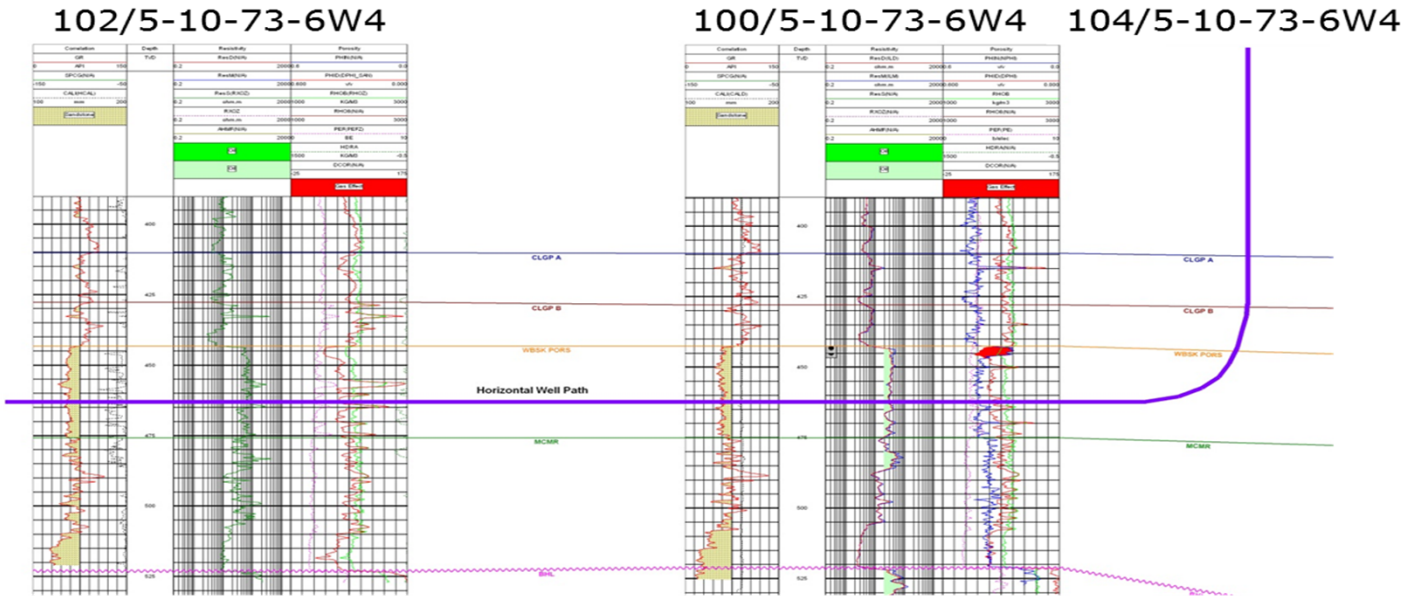
Horizontal production well 104/5-10

Producer drilled 15m below G/B interface:

- avoid hitting concretion
- avoid missing heated zone

Learnings:

- drill lower to optimize reserves recovery



Drilled in 2011 east of injector well at surface location 6-10
300m of horizontal leg landed 30m north of injector well and ~15m into heated zone

Drilling and completion

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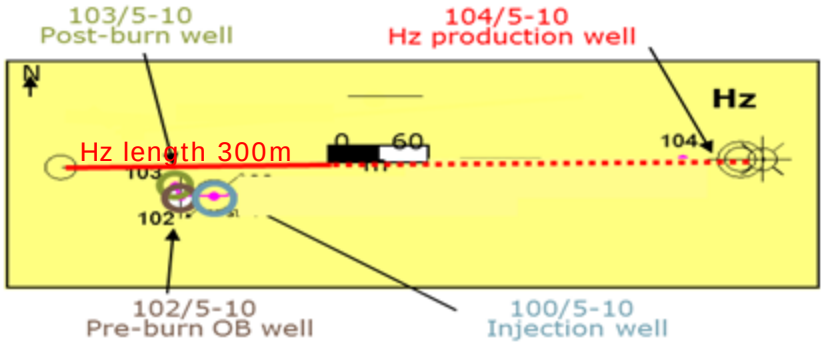
Well layout

Drilled 103/5-10-73-6W4 post burn vertical well September 2011

- Drilled 11m northwest of 102/5-10-73-6W4
- Successfully cored 44m from top Wabiskaw to top of McMurray – no lot core
  - extensive core ad oil analysis program completed
  - core routine core analysis, SEM, XRD
  - oil API, viscosity, composition

Drilled 104/5-10-73-6W4 horizontal producer well September 2011

- Drilled 300m east-west horizontal section, landed 30m north of 100/5-10-73-6W4 injector well and 15m below Wabiskaw gas/bitumen interface
- Well equipped with 20 thermocouples in horizontal length



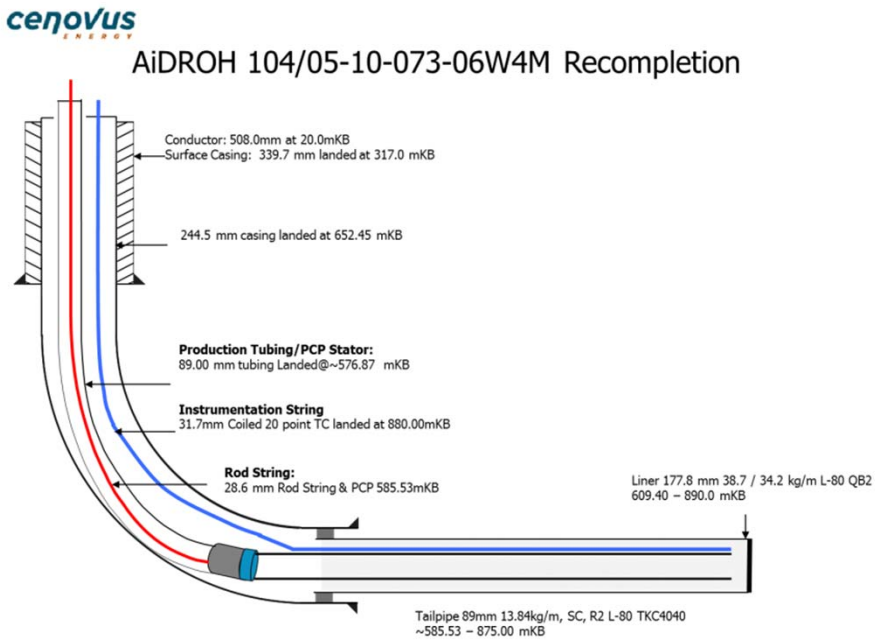
Completion

Installed tail pipe to toe

- divert hot crude to toe
- encourage warming near toe

Upsize artificial lift

- anticipate more influx as toe warms



Requirements under subsection 3.1.1 3c – wellbore schematics are included in the Appendix

Artificial lift

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Artificial lift

Artificial lift technology remains the same

- Progressive cavity pump (PCP), temperature tolerance of elastomer 150°C
- Lift capacity range: 34-50 m3/D
- Operating temperature range 44°C to 108°C

Artificial lift performance

Well produced from January 1, 2015 until well operations were suspended on February 13, 2015

- Significant volume of entrained gas ingested by the PCP

Instrumentation

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Subsurface section 5

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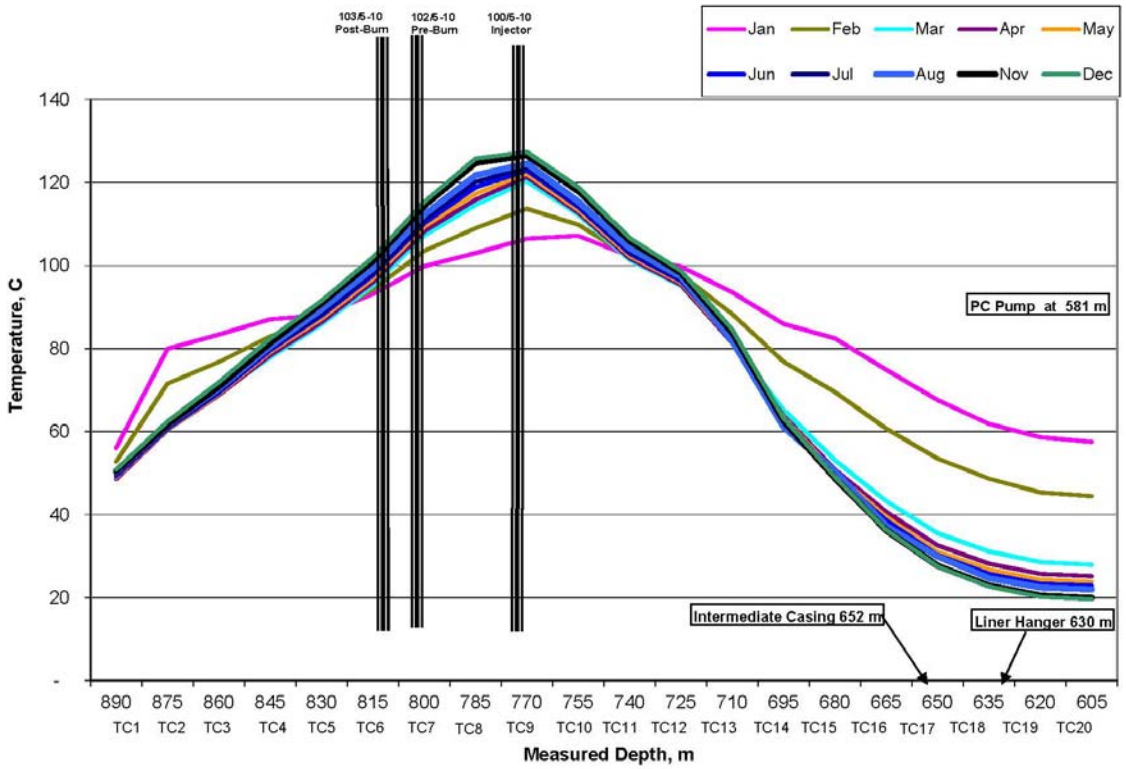
Instrumentation in wells

104/05-10-73-6W4/00

- Equipped with 10 thermocouples

Requirements under subsection 3.1.1 5a – wellbore schematics 5c and 5d are included in the Appendix

Thermocouple temp vs. depth



Scheme performance

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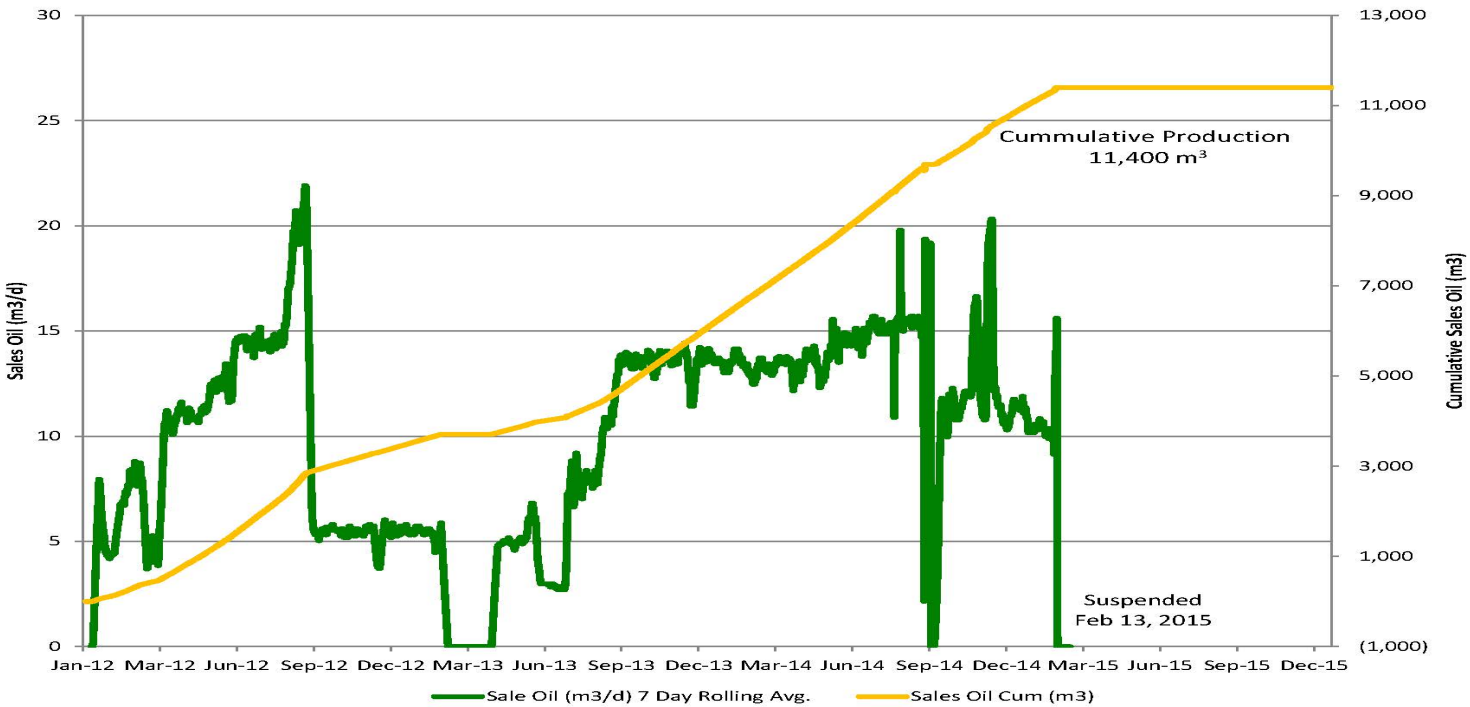
Production history



Heated oil volume

Calculated using analytical geometry-based method

Combustion front heats bitumen by conduction in the shape of a sphere cap

- Thermally affected radius ~ 260m

Chemically affected

- 50,000m^3

Thermal affected*

- 595,000m^3

Historical oil quality

Original oil ~45,000 cP at reservoir conditions (dead)

Sample No.	Viscosity(cSt), temp(°C)		
	25C	35C	50C
1	6469	2608	781
2	7510	2111	853
3	5006	2103	652
4	9073	2483	925
5	8013	2185	844
6	7994	2112	1022
7	7763	2971	860
8	8276	3050	884
9	8271	2410	923
10	5389	1646	662
11	8442	2338	894
12	7180	2449	926
13	6270	1583	737
14	10250	2922	1130
15	10955	3038	1153
16	10457	2919	1103
17	10267	2780	1091
18	9962	2813	1077

Sample No.	SARA, %			
	Asphaltene (C5 insoluble)	Saturates	Resins	Aromatics
1	13	26	11	50
2	14	25	13	49
3	14	26	13	47
4	14	24	13	49
5	15	25	13	47
6	12	25	11	52
7	13	28	8	52
8	15	23	16	46
9	16	24	11	49
10	13	24	9	54
11	13	24	13	50
12	14	24	13	49
13	14	23	10	53

No analysis conducted in 2015

BS&W

2014	BS&W
Q1	2.0%
Q2	1.0%
Q3	1.0%
Q4	7.5%

Subsurface key learnings

No casing gas pressure detected

- Gases likely being pulled into tailpipe
- Observed decrease in pump efficiency
- No H_2S detected

Toe section contributions inferred based on observed thermocouple data

- Jan 2015 ~ 10-15°C temperature increase observed

EnCAID conductive heating effects observed following suspension of well operations

- ~20°C temperature increase observed

Future plans

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Future plans

Continue the following:

- Monitor downhole temperatures
- Suspension of AIDROH well operations

AER Dir 54 Section 3.1.2

Surface operations, compliance and issues not related to resource evaluation and recovery

Surface operations: Table of contents

- Facility overview/modifications
- Measurement and reporting
- Water, water disposal well and landfill waste
- Sulphur production
- Environmental issues
- Compliance statement
- Non-compliance discussion
- Future plans

Facility overview/modifications

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Surface Operations section 1

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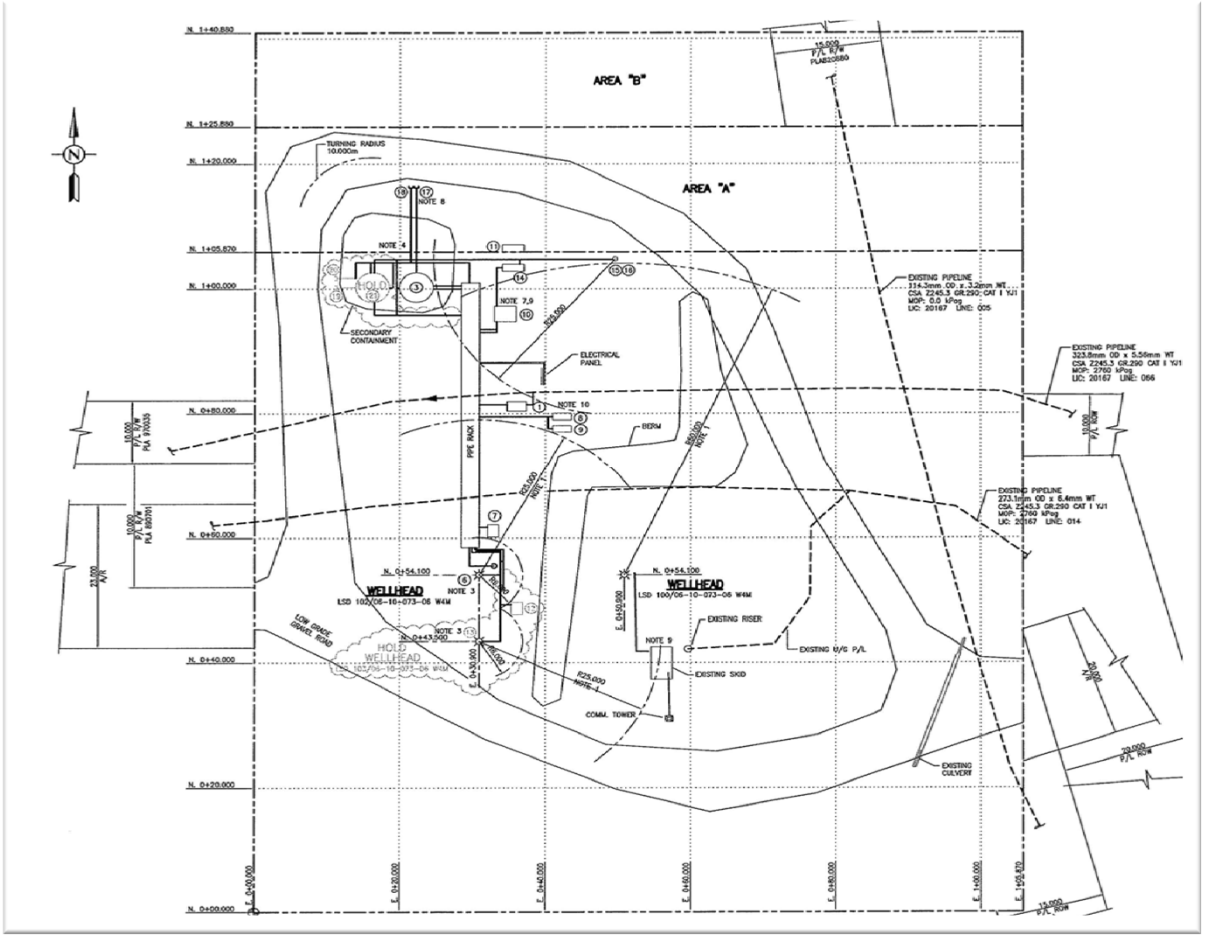
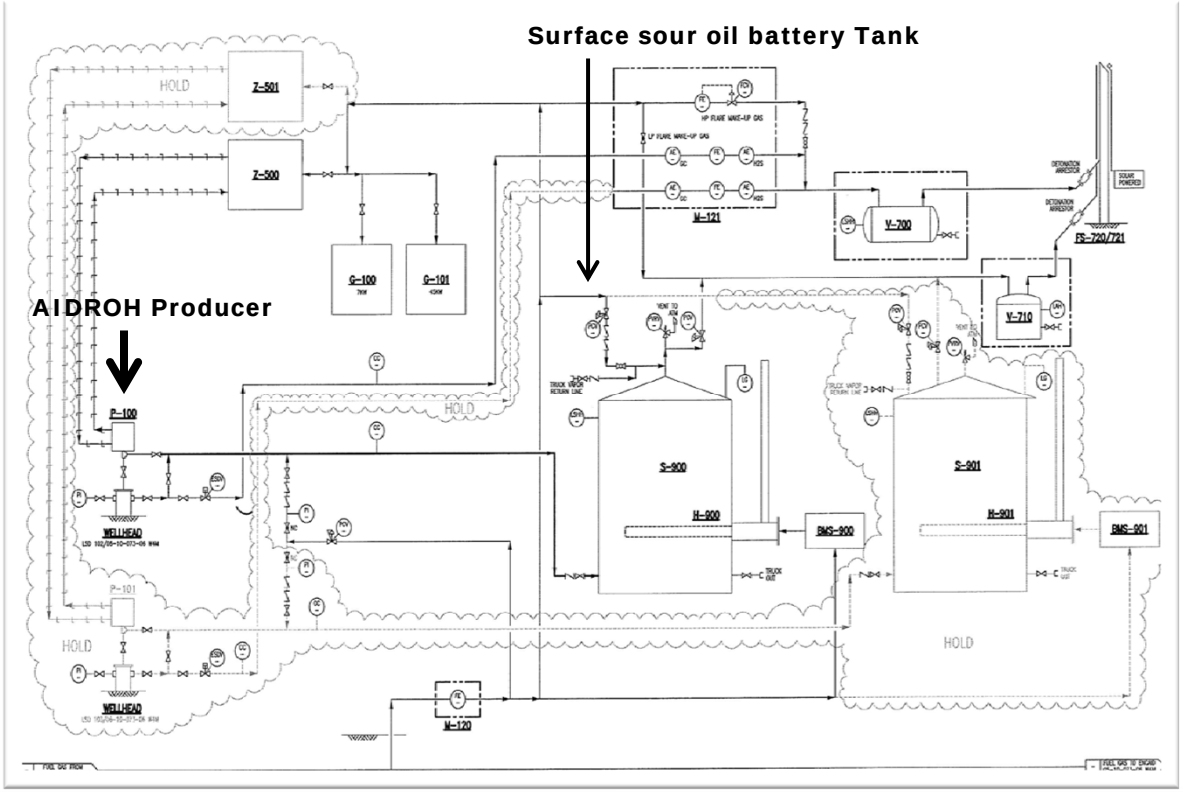
Site layout



Process flow schematic

Modification rationale

- Compliance with sour oil battery operations and license
- Sour rated vent



Facility performance 2015

Normal operations during production period

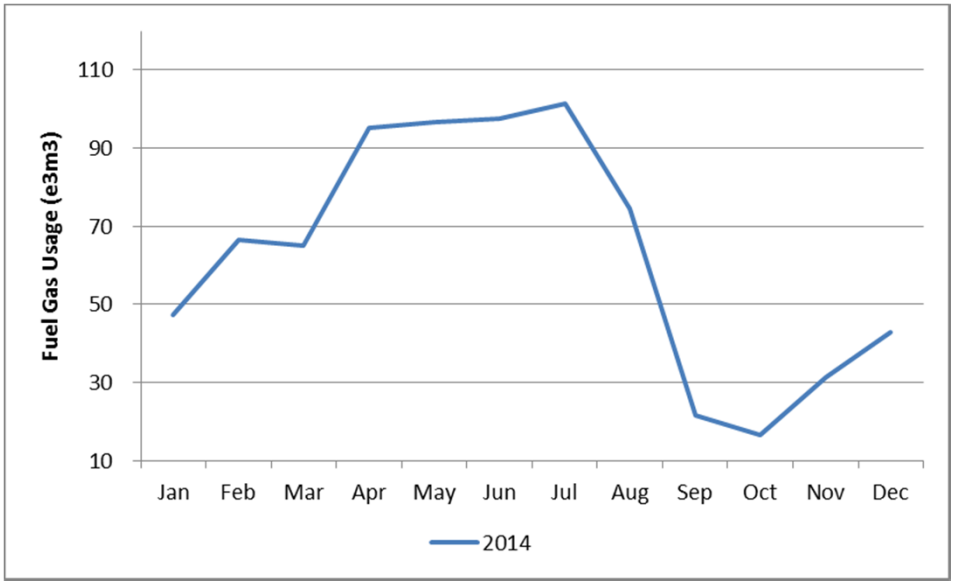
- January 1, 2015 to February 13, 2015

Suspended facility February 14, 2015

Gas usage

Usages are for blanket gases in sales oil tanks and incineration of produced sour gases

- Gas source Primrose plant sales
- Total usage 674 e^3m^3



Greenhouse gas emissions

Month	2015 (tonnes)	2014 (tonnes)
January	29	46
February	12	64
March	-	91
April	-	101
May	-	109
June	-	112
July	-	115
August	-	78
September	-	23
October	1	11
November	7	22
December	4	30

Measurement and reporting

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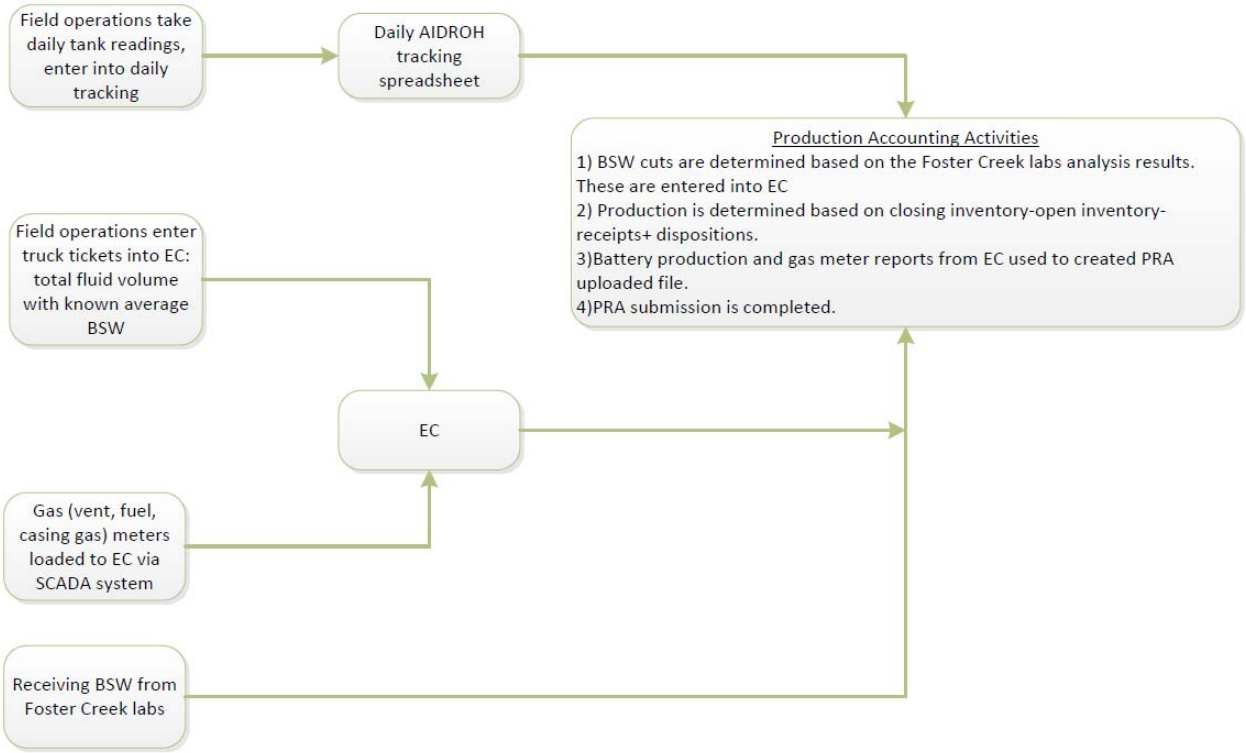
Measurement reporting



Water, water disposal wells and landfill waste

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Water and waste disposal

No produced water

Produced bitumen volumes typically ~7% BS&W

No processing occurs on site

All produced volumes are trucked out for processing

Sulphur production

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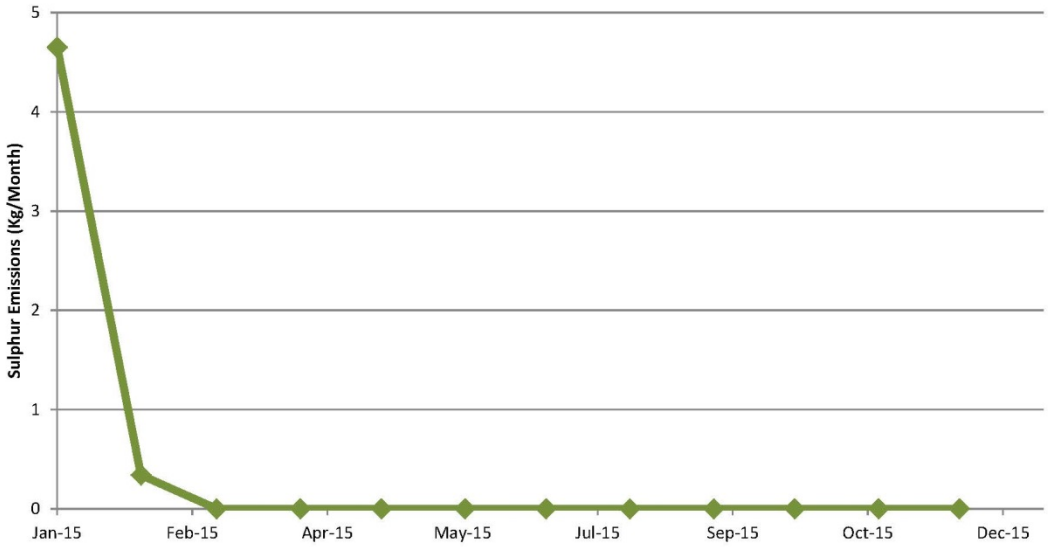
Sulphur production

No H2S detected after recompletion on Sept 2014

2014	Sulphur Emission, Kg
Q1	4.99
Q2	0
Q3	0
Q4	0



Environmental issues

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Environmental issues

No environmental issues occurred in 2015

Compliance statement

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Compliance confirmation

No non-compliance events occurred in 2015

Non-compliance discussion

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Compliance confirmation

No non-compliance events occurred in 2015

Future plans

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Future plans

Continue suspension of AIDROH well and facilities

Appendix

Wellbore schematic

Well Name: CVE FCCL 6-10 KIRBY 5-10-73-6

Schematic - Current (Landscape Layout)

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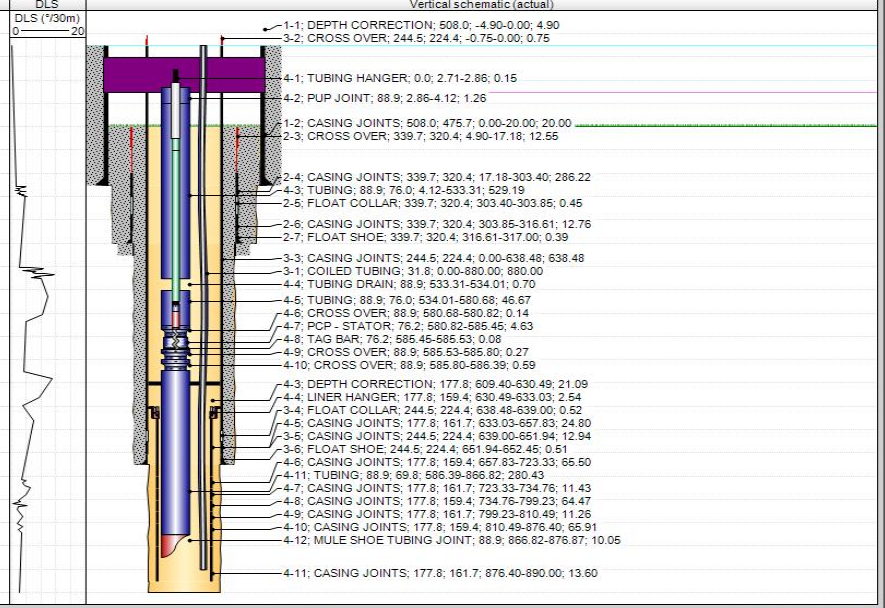
Bottom Hole UWI	Surface Legal Location	Pad	Profile Type	Sour Class(Uc)	Sour Status Date	Orig KB Elev (m)	Working GLE (m)	KB-CF (m)	KB-TH (m)	Total Depth (mKB)
104/05-10-073-06W4/00	LSD 6-10-73-6W4	6P-10-73-6 W4 FILE, 5/10	HORIZONTAL	UNKNOWN		694.40	689.50	2.91		905.00

Most Recent Job

Job Category	Type	Job Start Date	Job End Date
WORKOVER	OPTIMIZATION	2014-09-14	

HORIZONTAL - ORIGINAL HOLE, 2014-09-22 8:30:00 PM

MD (mKB)	TVD (mKB)	Incl (°)
-0.7	-0.7	0.0
1.1	1.1	0.0
2.8	2.8	0.1
4.1	4.1	0.2
4.9	4.9	0.2
12.7	12.7	0.5
17.2	17.2	0.7
303.4	297.2	22.1
303.9	297.7	22.1
317.0	309.8	23.1
321.4	313.8	23.4
534.0	456.6	72.8
557.9	462.2	79.8
580.8	465.7	82.4
585.8	466.3	82.8
609.0	467.7	89.9
630.5	467.3	91.3
638.5	467.2	90.6
651.9	467.2	90.3
657.8	467.1	90.3
734.8	466.8	89.4
810.5	467.8	89.2
876.4	467.2	90.9
880.0	467.2	90.9
905.0	466.8	91.0



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