

Appendix 13 - South Pierson Unit No 3 Planned Corrosion Control Program

Injection Wells

- Fiberglass tubing throughout the wellbore
- Wetted surfaces coated downhole packer
- Corrosion inhibited water in the annulus between tubing/casing
- Surface freeze protection of annular fluid
- Corrosion resistant master valve
- Corrosion resistant pipeline valve
- Casing cathodic protection where required

Producing Wells

- Downhole batch corrosion inhibition as required
- Downhole scale inhibitor injection as required
- Casing cathodic protection where required

Injection Wellhead / Surface Piping

- Corrosion resistant valves and internally coated surface piping

Pipelines

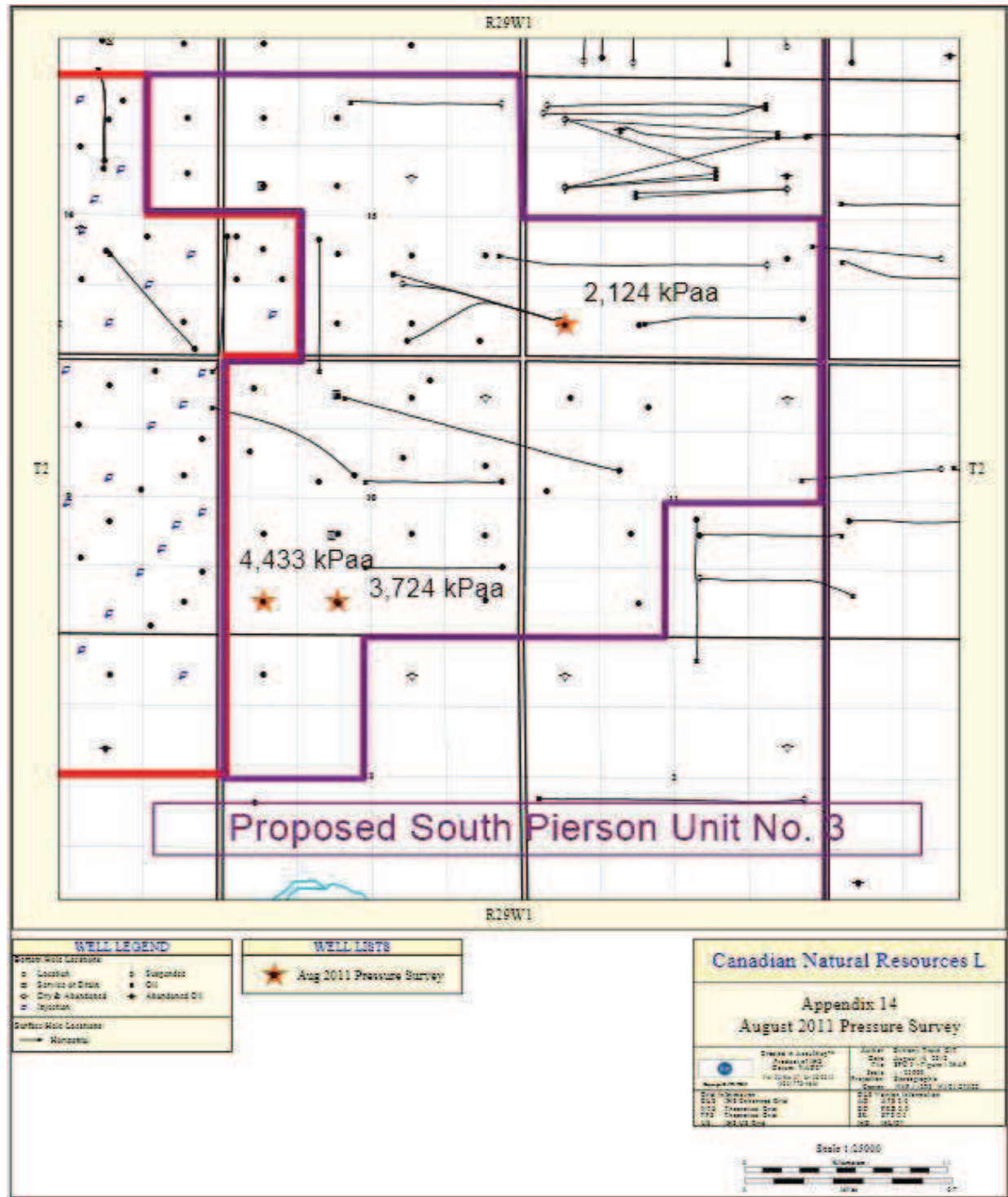
- Producing lines to have Star 1000# Fiberglass pipe
- Injection lines to have Star 2500# Fiberglass pipe

Facilities

- 14-09-02-29W1 Water Plant
 - Plant piping – Internally Coated
 - Filtration – Internally Coated
 - Pumping – Ceramic plungers, stainless steel disc valves
 - Tanks – Internally coated with corrosion resistant valves

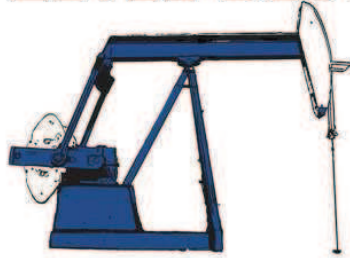
APPENDIX 14 - Pressure Survey Data and Summary

UWI	Date	SI Time (Hours)	SI Time (Days)	WC Pressure (kPaa)	Oil Pressure (kPaa)	Water Pressure (kPaa)	Type	Formation
100/04-10-002-29W1/0	8-Aug-11	2688	112	4433	4318	5659	Acoustic (Static)	SPRF
100/03-10-002-29W1/0	8-Aug-11	2256	94	3724	3724	3724	Acoustic (Static)	SPRF
100/04-14-002-29W1/0	8-Aug-11	2736	114	2124	2124	2124	Acoustic (Static)	SPRF



ACOUSTIC PRESSURE SURVEY
STATIC PRESSURE CALCULATION

LEVEL BEST



TECHNOLOGIES LTD.

CNRL PIERSON 4-10-2-29 (WPM)

100/04-10-002-29W1/0

License: 005879

Field: PIERSON MB

Formation: SPFISH

Pool: LOWER AMARANTH-MISSION CANYON 3B A

2011-AUG-08

DATA COLLECTION SERVICES

Prepared by: Sean Chakowski, C.E.T. (NR-Tec Ltd.)

Date: 2011-Aug-09

Prepared for: GRAHAM GUSTAFSON
CANADIAN NATURAL RESOURCES LIMITED

NR-Tec Ltd.

P.O. Box 36028 Lakeview RPO, Calgary, Alberta, Canada T3E 7C6

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CANADIAN NATURAL RESOURCES LIMITED

ACOUSTIC PRESSURE SURVEY (STATIC CALCULATION)

CNRL PIERSON 4-10-2-29 (WPM)

100/04-10-002-29W1/0

PIERSON MB

POOL: LOWER AMARANTH-MISSION CANYON 3B A

August 08, 2011

TEST SUMMARY:

- A surface pressure and a fluid level were obtained with an acoustic well sounder instrument on 2011-08-08 at 14:35 hours to calculate a shut-in bottomhole pressure at the mid-point of the producing interval.
- The subject well had been shut-in for 112 day(s) (since 08:00 on 2011-04-18).
- Since the fluid level was unknown at the time of shut-in, the fluid in the annulus is assumed to be an emulsion based on the water-cut of the fluid produced prior to shut-in. This results in a calculated bottomhole pressure of 4,433 kPa (absolute) at the mid-point of the producing interval.
- Assuming the annular column is 100% oil results in a pressure of 4,318 kPa (absolute) and assuming the annular column is 100% water results in a pressure of 5,659 kPa (absolute).

PRESSURE DATA CALCULATIONS:

- The bottomhole pressures were calculated using the following information:

Atmospheric Pressure	93.0 kPa
Formation Depth	1,023.50 m KB
Oil Gravity	34.50 °API
Water Gravity	1.130
Gas Gravity	0.817
Oil Production	1.00 m ³ /d
Water Production	0.10 m ³ /d
Gas Production	0.00 E ³ m ³ /d
Bottomhole Temperature	55.00 °C

ATTACHMENTS:

ACOUSTIC WELLSOUNDER PRESSURE SURVEY DATA



ACOUSTIC WELLSOUNDER PRESSURE SURVEY

COMPANY: CANADIAN NATURAL RESOURCES LIMITED	POOL: LOWER AMARANTH-MISSION C	U.W.I.: 100/04-10-002-29W1/0
FIELD: PIERSON MB	WELL STATUS: OIL	WELL NAME: CNRL PIERSON 4-10-2-29 (WPM)
SHUT-IN: 2011-Apr-18 @ 08:00:00	LICENSE: 005879	

ELEVATIONS:

Kelly Bushing (KB): 472.80 m
Ground Level (GL): 468.60 m
KB to GL: 4.20 m

FLUID PROPERTIES:

Gas Gravity: 0.817
Oil Gravity: 34.500 °API
Water Gravity: 1.130

TEMPERATURES:

Surface: 2.50 °C
Reservoir: 55.00 °C

PRODUCTION RATES:

Gas: 0.00 E³m³/d
Oil: 1.00 m³/d
Water: 0.10 m³/d

PRODUCING INTERVAL:

Top: 1,020.50 m KB
Bottom: 1,026.50 m KB
Mid-Point: 1,023.50 m KB

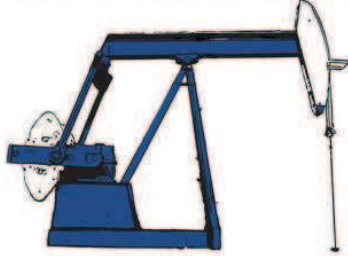
NOTES:

NO.	TEST TIME	DATE	TIME	JOINTS TO LIQUID	SURFACE PRESSURE (kPaa)	GAS COLUMN			OIL COLUMN			EMULSION COLUMN			PRESSURE @ MPP (kPaa)
	(hours)					HEIGHT (m)	GRADIENT (kPa/m)	PRESSURE (kPa)	HEIGHT (m)	GRADIENT (kPa/m)	PRESSURE (kPa)	HEIGHT (m)	GRADIENT (kPa/m)	PRESSURE (kPa)	
1	2694.583	2011-Aug-08	14:35:00	58.70	603.0	561.3	0.061	34.4	--	--	--	458.0	8.287	3795.8	4433.2



ACOUSTIC PRESSURE SURVEY
STATIC PRESSURE CALCULATION

LEVEL BEST



TECHNOLOGIES LTD.

CNRL PIERSON 3-10-2-29(WPM)

100/03-10-002-29W1/0

License: 006043

Field: PIERSON MB

Formation: SPFISH

Pool: LOWER AMARANTH-MISSION CANYON 3B A

2011-AUG-08

DATA COLLECTION SERVICES

Prepared by: Sean Chakowski, C.E.T. (NR-Tec Ltd.)

Date: 2011-Aug-09

Prepared for: GRAHAM GUSTAFSON
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CANADIAN NATURAL RESOURCES LIMITED

ACOUSTIC PRESSURE SURVEY (STATIC CALCULATION)

CNRL PIERSON 3-10-2-29(WPM)

100/03-10-002-29W1/0

PIERSON MB

POOL: LOWER AMARANTH-MISSION CANYON 3B A

August 08, 2011

TEST SUMMARY:

- A surface pressure and a fluid level were obtained with an acoustic well sounder instrument on 2011-08-08 at 14:45 hours to calculate a shut-in bottomhole pressure at the mid-point of the producing interval.
- The subject well had been shut-in for 94 day(s) (since 08:00 on 2011-05-06).
- A bottomhole pressure of 3,724 kPa (absolute) was calculated at the mid-point of the producing interval.

PRESSURE DATA CALCULATIONS:

- The bottomhole pressures were calculated using the following information:

Atmospheric Pressure	93.0 kPa
Formation Depth	1,024.00 m KB
Oil Gravity	34.50 °API
Water Gravity	1.130
Gas Gravity	0.817
Oil Production	0.24 m ³ /d
Water Production	0.00 m ³ /d
Gas Production	0.00 E ³ m ³ /d
Bottomhole Temperature	55.00 °C

ATTACHMENTS:

ACOUSTIC WELLSOUNDER PRESSURE SURVEY DATA



ACOUSTIC WELLSOUNDER PRESSURE SURVEY

COMPANY: CANADIAN NATURAL RESOURCES LIMITED	POOL: LOWER AMARANTH-MISSION C	U.W.I.: 100/03-10-002-29W1/0
FIELD: PIERSON MB	WELL STATUS: OIL	WELL NAME: CNRL PIERSON 3-10-2-29 (WPM)
SHUT-IN: 2011-May-06 @ 08:00:00	LICENSE: 006043	

ELEVATIONS:

Kelly Bushing (KB): 473.60 m
Ground Level (GL): 469.60 m
KB to GL: 4.00 m

FLUID PROPERTIES:

Gas Gravity: 0.817
Oil Gravity: 34.500 °API
Water Gravity: 1.130

TEMPERATURES:

Surface: 2.50 °C
Reservoir: 55.00 °C

PRODUCTION RATES:

Gas: 0.00 E³m³/d
Oil: 0.24 m³/d
Water: 0.00 m³/d

PRODUCING INTERVAL:

Top: 1,021.00 m KB
Bottom: 1,027.00 m KB
Mid-Point: 1,024.00 m KB

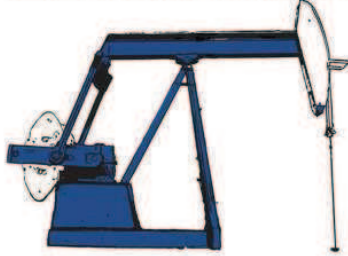
NOTES:

NO.	TEST TIME	DATE	TIME	JOINTS TO LIQUID	SURFACE PRESSURE (kPaa)	GAS COLUMN			OIL COLUMN			EMULSION COLUMN			PRESSURE @ MPP (kPaa)
	(hours)					HEIGHT (m)	GRADIENT (kPa/m)	PRESSURE (kPa)	HEIGHT (m)	GRADIENT (kPa/m)	PRESSURE (kPa)	HEIGHT (m)	GRADIENT (kPa/m)	PRESSURE (kPa)	
1	2262.750	2011-Aug-08	14:45:00	67.30	672.0	645.8	0.068	44.1	374.2	8.037	3007.8	--	--	--	3723.9



ACOUSTIC PRESSURE SURVEY
STATIC PRESSURE CALCULATION

LEVEL BEST



TECHNOLOGIES LTD.

HOME SCURRY S PIERSON PROV 4-14-2-29

100/04-14-002-29W1/0

License: 004189

Field: PIERSON MB

Formation: SPFISH

Pool: LOWER AMARANTH-MISSION CANYON 3B A

2011-AUG-08

DATA COLLECTION SERVICES

Prepared by: Sean Chakowski, C.E.T. (NR-Tec Ltd.)

Date: 2011-Aug-09

Prepared for: GRAHAM GUSTAFSON
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CANADIAN NATURAL RESOURCES LIMITED

ACOUSTIC PRESSURE SURVEY (STATIC CALCULATION)

HOME SCURRY S PIERSON PROV 4-14-2-29

100/04-14-002-29W1/0

PIERSON MB

POOL: LOWER AMARANTH-MISSION CANYON 3B A

August 08, 2011

TEST SUMMARY:

- A surface pressure and a fluid level were obtained with an acoustic well sounder instrument on 2011-08-08 at 14:23 hours to calculate a shut-in bottomhole pressure at the mid-point of the producing interval.
- The subject well had been shut-in for 114 day(s) (since 08:00 on 2011-04-16).
- A bottomhole pressure of 2,124 kPa (absolute) was calculated at the mid-point of the producing interval.

PRESSURE DATA CALCULATIONS:

- The bottomhole pressures were calculated using the following information:

Atmospheric Pressure	93.0 kPa
Formation Depth	1,014.00 m KB
Oil Gravity	34.50 °API
Water Gravity	1.130
Gas Gravity	0.817
Oil Production	0.04 m ³ /d
Water Production	0.00 m ³ /d
Gas Production	0.00 E ³ m ³ /d
Bottomhole Temperature	55.00 °C

ATTACHMENTS:

ACOUSTIC WELLSOUNDER PRESSURE SURVEY DATA



ACOUSTIC WELLSOUNDER PRESSURE SURVEY

COMPANY:	CANADIAN NATURAL RESOURCES LIMITED	POOL:	LOWER AMARANTH-MISSION C	U.W.I.:	100/04-14-002-29W1/0
FIELD:	PIERSON MB	WELL STATUS:	OIL	WELL NAME:	HOME SCURRY S PIERSON PROV 4-14-2-29
SHUT-IN:	2011-Apr-16 @ 08:00:00	LICENSE:	004189		

ELEVATIONS:

Kelly Bushing (KB): 470.70 m
Ground Level (GL): 466.30 m
KB to GL: 4.40 m

FLUID PROPERTIES:

Gas Gravity: 0.817
Oil Gravity: 34.500 °API
Water Gravity: 1.130

TEMPERATURES:

Surface: 2.50 °C
Reservoir: 55.00 °C

PRODUCTION RATES:

Gas: 0.00 E³m³/d
Oil: 0.04 m³/d
Water: 0.00 m³/d

PRODUCING INTERVAL:

Top: 1,011.00 m KB
Bottom: 1,017.00 m KB
Mid-Point: 1,014.00 m KB

NOTES:

NO.	TEST TIME	DATE	TIME	JOINTS TO LIQUID	SURFACE PRESSURE (kPaa)	GAS COLUMN			OIL COLUMN			EMULSION COLUMN			PRESSURE @ MPP (kPaa)
	(hours)					HEIGHT (m)	GRADIENT (kPa/m)	PRESSURE (kPa)	HEIGHT (m)	GRADIENT (kPa/m)	PRESSURE (kPa)	HEIGHT (m)	GRADIENT (kPa/m)	PRESSURE (kPa)	
1	2742.383	2011-Aug-08	14:23:00	85.50	437.0	804.7	0.044	35.1	204.9	8.062	1652.1	--	--	--	2124.2



Downhole Schematic



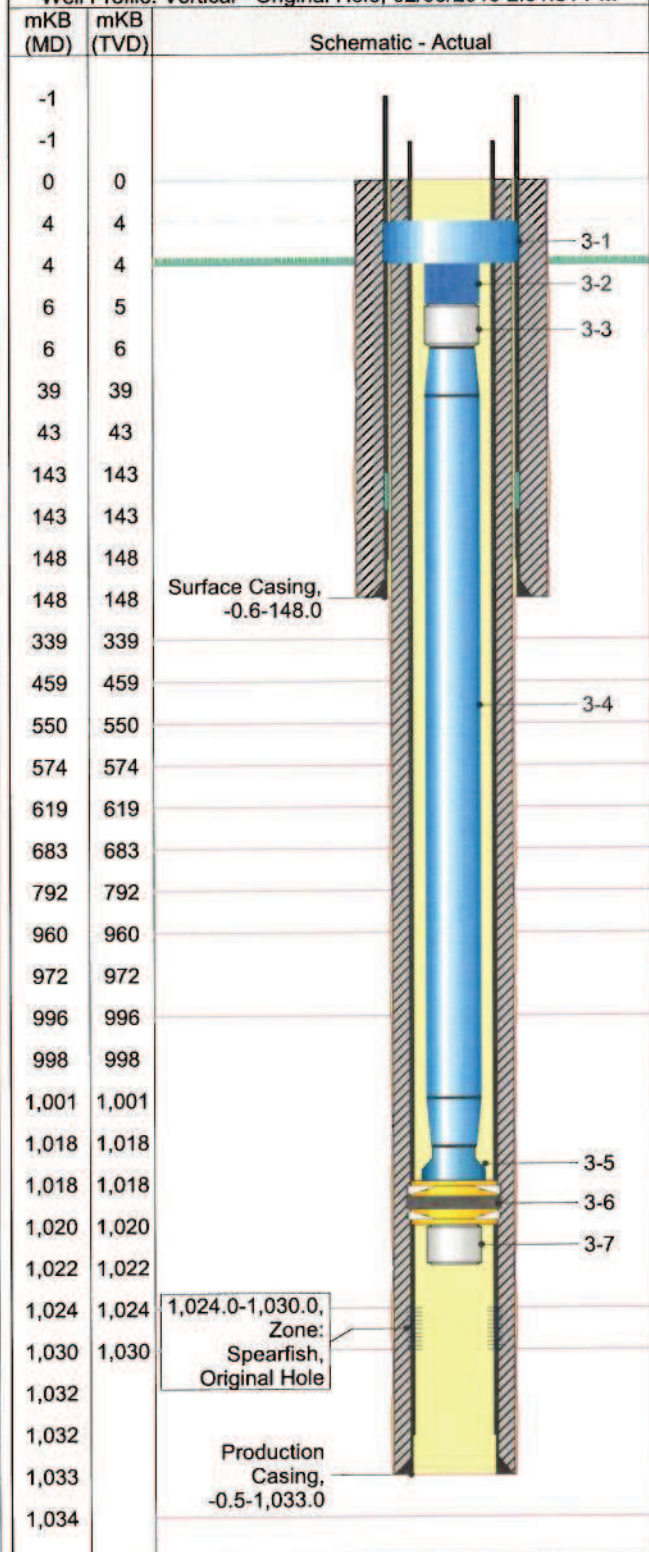
Canadian Natural

SOUTH PIERSON UNIT NO 3 (Typical Injector Wellbore)

Bottom Hole Location	Surface Legal Location	License No.	Field Name PIERSON	Province Manitoba	
Well Profile Vertical	Fluid Type Oil	Original KB Elevation (m) 479.99	KB-Ground Distance (m) 3.95	KB-Casing Flange Distance (m) 3.75	KB-Tubing Head Distance (m) 3.35

Directions To Well

Well Profile: Vertical - Original Hole, 02/05/2010 2:01:31 PM



PBTDs

Date	Depth (mKB)

Casing Strings

Casing Description	OD (mm)	Wt (kg/m)	Grade	Set Depth (MD) (mKB)
Surface Casing	177.8	25.299	H-40	148.00
Production Casing	114.3	14.138	J-55	1,033.00

Cement Stages

Description	Type	Top (mKB)	Btm (mKB)	Rtns Mix (%)	Rtns Displ. (%)	Cmnt Rtn (m³)
Surface Cement	casing	0.00	148.00	100	100	2.00
Production Cement	casing	0.00	1,033.00	100	100	2.50

Perforations

Zone	Top (mKB)	Btm (mKB)	Current Status
Spearfish, Original Hole	1,024.00	1,030.00	

Tubing Strings

Tubing - Production set at 1,021.56mKB on 07/13/2008 00:00

Tubing Description	OD (mm)	Wt (kg/m)	String Grade	Set Depth (mKB)
Tubing - Production	71.6	2.560	DH2500	1,021.56

Comment

Eskimo 10k Monel Coated DG injection packer c/w 45.97mm R profile, 20,000# rotational shear. Fiberglass Tbg string is in 3,500 DaN Tension

Item No.	Jts	Item Description	OD (mm)	ID (mm)	Len (m)	Top (mKB)	Btm (mKB)
3-1	1	Extended Neck T.H.	179.0		0.18	3.76	3.94
3-2		Required Stretch	71.6		1.54	3.94	5.48
3-3	1	Centron DH 2500 Nipple	71.6	50.7	0.16	5.48	5.64
3-4	114	Centron DH2500 Fiberglass Tbg	71.6	50.7	1,012.39	5.64	1,018.03
3-5	1	Cross Over Swedge	82.6	50.7	0.16	1,018.03	1,018.19
3-6	1	EIP Injection Packer(D.G. 10k)	114.0	46.0	1.84	1,018.19	1,020.03
3-7	1	DH2500 Centron Fiberglass pup	71.6	50.7	1.53	1,020.03	1,021.56

Wellheads

Type	Make
Casing Bowl	Stream-Flo
Flanged 900 series	Crown "A3"
Flanged 900 series	Stream-Flo