EXTENDING TUBING LIFE WITH ENDURALLOY TUBING

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INTRODUCTION

Pioneer Natural Resources has been committed to Downhole Failure Reduction since its creation in 1997. The success of their Failure Reduction Programs can be attributed to the use of new technology and all levels of field personnel trained with this new technology.

The Spraberry Field is an important asset of Pioneer Natural Resources. This Field is responsible for 25% of Pioneer's worldwide production and 50% of Pioneer's proven reserves. This Field is an important asset because of stable production, low maintenance costs and low capital costs. Pioneer's successful Failure Reduction Programs have been an important factor in protecting and utilizing this asset.

Pioneer Natural Resources as of September 30, 2009 had a Total Failure Rate of 0.28 failures per well per year (FPWPY) in the Spraberry Field. This translates to a Mean Time Between Failures (MTBF) of 3.57 years. Since all downhole failures in a sucker rod lift system (Tubing, Rod or Pump) contribute to lease operating costs it is important to create Failure Reduction Programs that are best defined by the phrase "continuous improvement".

PROGRAM OBJECTIVES

1. Increase Mean Time Between Failures (MTBF) from 3.57 to 5.0 years in all Spraberry Wells by extending tubing life.
2. Extend tubing life by strategically installing EndurAlloy Tubing in 18 Newly Drilled Wells.
3. Track performance of these 18 Newly Drilled Wells from August 4, 2006 to January 27, 2009 for this paper presentation.
4. Continue monitoring tubing life performance to evaluate reaching Mean Time Between Failure (MTBF) goal of 5.0 years.

ENDURALLOY PROCESS

EndurAlloy is a process that controls the diffusion of boron into the substrate of steel and steel alloys. This diffusion of boron that penetrates the surface of the base metal provides improved corrosion resistance and increased hardness. This process is applied to the inside diameter to the end root threads at a thickness of 0.008" to 0.010".

For comparison, J-55 tubing has hardness range of 23 - 32 Rockwell C. The EndurAlloy process increases this hardness range to 73 - 90 Rockwell C.

NEWLY DRILLED WELL INSTALLATION

All of the 18 New Drilled Wells selected for this Failure Reduction Program were initially placed on production as follows;

Pumping Unit:
Conventional Pumping Units
228-246-86
Surface Stroke of 86"
Pumping Speed of 10 spm
Pump Plunger Diameters from 1.25' to 1.50"

Rod String Designs (Top to Bottom):

Taper-1	50' to 1,200'	7/8" Steel Rods
Taper 2	3,000'	1.0" Fiberglass Rods
Taper 3	2,175' to 3,825'	7/8" Steel Rods
Taper 4	500' to 625'	1.5" Grade-C Sinkerbars

Tubing String Designs (Top to Bottom):

223 Joints of 2-3/8" O.D., Non-Coated I.D., J-55 Tubing
6 Joints of 2-3/8" O.D., EndurAlloy Coated I.D. J-55 Tubing

Average Seating Nipple Depth:

7,219 feet

Production Casing:

4.0" I.D.

INITIAL RESULTS

Since the initial installation on August 4, 2006 of 6 joints of EndurAlloy Tubing, the 18 wells have experienced a total of 19 Well Service Events. Out of these 19 Well Service Events, there was 1 new zone recompletion and 1 failure that not identified. The remaining 17 identified failures were as follows;

Tubing Leaks	8	47 %
Rod Failures	8	47 %
Pump Failures	1	6 %
Total Failures	17	100 %

Upon further investigation, it was discovered that ten (10) wells of the initial eighteen (18) well tubing installations were altered from the initial designs utilizing 6 joints of EndurAlloy Tubing installed below 223 joints of uncoated Tubing. A performance summary of the ten (10) wells is listed below;

6 Wells	Bare 2-3/8" Tubing - IPC tubing - EndurAlloy Tubing	12 Well Service Events
3 Wells	Bare 2-3/8" Tubing - EndurAlloy - IPC Tubing	6 Well Service Events
1 Well	Bare 2-3/8" Tubing - EndurAlloy Tubing	1 Well Service Event

The remaining total of eight (8) wells have operated from August 4, 2006 to January 27, 2009 with no change to the original tubing design utilizing 6 jts of EndurAlloy Tubing installed below 223 jts of non-coated tubing. A performance summary of these eight (8) wells is listed below;

8 Wells	Bare 2-3/8" Tubing - EndurAlloy Tubing	0 Well Service Events

PERFORMANCE BY TUBING DESIGN

INITIAL "BARE – ENDURALLOY" TO CURRENT "BARE - IPC – ENDURALLOY" DESIGNS

There were a total of six (6) wells that experienced a total of 12 Well Service Events for 11 failures in 2.5 years. These wells were initially installed with the following sequence of tubing;

Initial Design; 221-232 joints of bare 2-3/8" tubing
6 joint of EndurAlloy 2-3/8" tubing
Current Design: 186-217 joints of bare 2-3/8" tubing
15- 40 joints of IPC 2-3/8" tubing
6 joints of EndurAlloy 2-3/8" tubing

Lease Name and Well No.	Description of Failure	Tubing Leak	Rod Failure	Pump Failure
1. Blocker A Lease, Well No. 2	1.1 years with 6 jts EndurAlloy Tubing Leak in Seating Nipple 15 IPC above 6 EndurAlloy 1.4 years with IPC-EndurAlloy	01	00	00

2. Hazelwood C Lease, Well No. 7	0.2 years with 6 jts EndurAlloy			
	Rod Failure – On Off Tool Failure	00	01	00
	0.9 years with 6 jts EndurAlloy			
	Tbg Lk 43 jap (In Bare Tubing)	01	00	00
	35 jts IPC above 6 jts EndurAlloy			
	1.4 years with IPC-EndurAlloy			
3. Howard Lease, Well No. 6	0.3 years with 6 jts EndurAlloy			
	Tbg Lk 23 jap (In Bare Tubing)	01	00	00
	Increased EndurAlloy to 16 jts			
	0.6 years with EndurAlloy			
	No Failure Found	00	00	00
	20 jts IPC above 16 jts EndurAlloy			
	1.5 years with IPC-EndurAlloy			
4. Hooper 39 Lease, Well No. 1	1.0 years with 6 jts EndurAlloy			
	7/8" Rod Box Failure	00	01	00
	16 jts IPC above 5 jts EndurAlloy			
	1.4 years with IPC-EndurAlloy			
5. Glasscock AA Lease, Well No. 4	0.3 years with 6 jts EndurAlloy			
	Tbg Lk 19 jap (In Bare Tubing)	01	00	00
	6 jts EndurAlloy above 20 jts IPC			
	0.8 years with EndurAlloy-IPC			
	Tbg Lk 32 jap (In Bare Tubing)	01	00	00
	40 jts IPC to above 6 jts EndurAlloy			
	1.3 years with IPC-EndurAlloy			
6. Greeman-Grisham Lease, Well No. 5	0.3 years with 6 jts EndurAlloy			
	Tbg Lk 20 jap (In Bare Tubing)	01	00	00
	6 jts EndurAlloy above 20 jts IPC			
	0.1 years with EndurAlloy-IPC			
	7/8" Rod Box Failure	00	01	00
	0.1 years with EndurAlloy-IPC			
	Tbg Lk 29 jap (In Bare Tubing)	01	00	00
	50 jts IPC below 6 jts EndurAlloy			
	1.0 year with EndurAlloy-IPC			
	7/8" Rod Box Failure	00	01	00
	30 jts IPC above 6 jts EndurAlloy			
	0.9 years with IPC-EndurAlloy			
Total Failures by Failure Type:		07	04	00

For 6 Wells - After 2.5 Years – Mean Time Between 7 Tubing Leaks	0.59 Years
For 6 Wells - After 2.5 Years – Mean Time Between 11 Failures	0.55 Years
For 6 Wells - After 2.5 Years – Mean Time Since Last Failure (Bare-IPC-EndurAlloy)	1.30 Years

INITIAL "BARE - ENDURALLOY" TO CURRENT "BARE - ENDURALLOY- IPC" DESIGNS

There were a total of three (3) wells that experienced a total of 6 Well Service Events in 2.5 years. These wells were initially installed with the following sequence of tubing;

Initial Design; 213-222 joints of bare 2-3/8" tubing
6 joints of EndurAlloy 2-3/8" tubing
Current Design: 190-202 joints of bare 2-3/8" tubing
6-10 joints of EndurAlloy 2-3/8" tubing
19-20 joints of IPC 2-3/8" tubing

Lease Name and Well No.	Description of Failure	Tubing Leak	Rod Failure	Pump Failure
1. Richards Lease, Well No. 3	0.2 years with 6 jts EndurAlloy			
	Pump Failure	00	00	01
	6 jts EndurAlloy above 19 jts IPC			

	0.4 years with EndurAlloy-IPC			
	7/8" Rod Box Failure	00	01	00
	0.9 years with EndurAlloy-IPC			
	7/8" Rod Pin Failure	00	01	00
	0.9 years with EndurAlloy-IPC			
2. Greeman-Grishman Lease, Well No. 6	0.4 years with 6 jts EndurAlloy			
	7/8" Rod Box Failure	00	01	00
	6 jts EndurAlloy above 20 jts IPC			
	1.1 years with EndurAlloy-IPC			
	7/8" Rod Box Failure	00	01	00
	0.7 years with EndurAlloy-IPC			
3. Kentex Lease, Well No. 6	0.3 years with 6 jts EndurAlloy			
	Recompletion	00	00	00
	6 jts EndurAlloy above 20 jts IPC			
	1.9 years with EndurAlloy-IPC			
Total Failures by Failure Type:		00	04	01

For 3 Wells - After 2.5 Years – Mean Time Between 0 Tubing Leaks	> 2.5 Years
For 3 Wells - After 2.5 Years – Mean Time Between 5 Failures	0.60 Years
For 3 Wells - After 2.5 Years – Mean Time Since Last Failure (Bare-EndurAlloy-IPC)	1.20 Years

INITIAL "BARE - ENDURALLOY" TO CURRENT "BARE - ENDURALLOY"
(Separated Out Because of Single Tubing Leak)
There were a total of one (1) well that experienced a total of 1 Well Service Event in 2.5 years. This well was initially installed with the following sequence of tubing;

Initial Design; 213 joints of bare 2-3/8" tubing
6 joints of EndurAlloy 2-3/8" tubing
Current Design: 213 joints of bare 2-3/8" tubing
6 joints of EndurAlloy 2-3/8" tubing

Lease Name and Well No.	Description of Failure	Tubing Leak	Rod Failure	Pump Failure
1. Rayford McAlister Lease, Well No. 2	0.8 Years with 6 jts EndurAlloy			
	Tbg Lk 41 jap (In Bare Tubing)	01	00	00
	1.4 Years with EndurAlloy			
Total Failures by Failure Type:		01	00	00

For 1 Well - After 2.5 Years – Mean Time Between 1Tubing Leak	0.80 Years
For 1 Well - After 2.5 Years – Mean Time Between 1 Failure	0.80 Years
For 1 Well - After 2.5 Years – Mean Time Since Last Failure (Bare-EndurAlloy)	1.40 Years

INITIAL "BARE – ENDURALLOY" TO CURRENT "BARE - ENDURALLOY"
The remaining eight (8) wells have operated with the initial tubing design and have not experienced any failures.

Initial Design; 213-259 joints of bare 2-3/8" tubing
6 joints of EndurAlloy 2-3/8" tubing
Current Design: 213-259 joints of bare 2-3/8" tubing
6 joints of EndurAlloy 2-3/8" tubing

Lease Name and Well No.	Description of Failure	Tubing Leak	Rod Failure	Pump Failure
1. Lawson A Lease, Well No. 8	2.4 Years with 6 jts EndurAlloy			
	No Failure to Date	00	00	00
2. Jones E Lease, Well No 2	2.4 Years with 6 jts EndurAlloy			
	No Failure to Date	00	00	00

3. Kentex Lease, Well No. 5	2.2 Years with 6 jts EndurAlloy No Failure to Date	00	00	00
4. Tank Farm Lease, Well No. 14	2.1 Years with 6 jts EndurAlloy No Failure to Date	00	00	00
5. Erwin C Lease, Well No. 5	2.2 Years with 6 jts EndurAlloy No Failure to Date	00	00	00
6. Erwin C Lease, Well No. 9	2.1 Years with 6 jts EndurAlloy No Failure to Date	00	00	00
7. Erwin H Lease, Well No. 3	2.1 Years with 6 jts EndurAlloy No Failure to Date	00	00	00
8. Guerin Lease, Well No. 2	2.1 Years with 6 jts EndurAlloy No Failure to Date	00	00	00
Total Failures by Failure Type:		00	00	00

For 8 Wells - After 2.5 Years – Mean Time Between 0Tubing Leaks	> 2.5 Years
For 8 Wells - After 2.5 Years – Mean Time Between 0 Failures	> 2.5 Years
For 8 Wells - After 2.5 Years – Mean Time Since Last Failure (Bare-EndurAlloy)	2.2 Years

PROGRAM RESULTS

In 2006, a total of 18 producing Spraberry wells were selected for this failure reduction program. The goal of this program was to increase the Mean Time Between Failures by reducing the frequency of Tubing Leaks in these selected wells. The process was to strategically install EndurAlloy Tubing and monitor the frequency of Tubing Leaks and frequency of Total Failures.

Since August 4, 2006 failure performance has been monitored for these 18 selected wells. This paper will report the performance of these wells through January 27, 2009.

All 18 wells were initially installed with bare 2-3/8" tubing and 6 joints of 2-3/8" EndurAlloy tubing on the bottom of each tubing string. Since installation of the EndurAlloy tubing there have been a total of 19 Well Service Events that included 17 failures and 2 non-failures) in a total of 10 wells.

Listed below is a summary of each final tubing design described from top to bottom and the associated Mean Time Between Tubing Leaks (MTBTL), Mean Time Between Failures (MTBF) and Mean Time Since Last Failure (MTSLF);

	Final Tubing Design	(MTBTL)	(MTBF)	(MTSLF)
6 Wells	Bare – IPC – EndurAlloy	0.59 years	0.55 Years	1.30 Years
3 Wells	Bare - EndurAlloy - IPC	> 2.3 Years	0.60 Years	1.20 Years
1 Well	Bare - EndurAlloy	0.80 Years	0.80 Years	1.40 Years
8 Wells	Bare – EndurAlloy	>2.2 Years	>2.2 Years	2.20 Years

CONCLUSIONS

1. Increased Mean Time Between Failures (MTBF) appears possible, but continued monitoring of failure performance is necessary to exceed current 3.57 years between failures.
2. No EndurAlloy Tubing in this program experienced a Tubing Leak
3. Best Mean Time Between Failures (MTBF) occurred when EndurAlloy was located on bottom of each tubing string
4. A better method is required to identify EndurAlloy Tubing by "sight"
5. Continue to confirm and document all Tubing Leaks
6. Any changes to initial tubing design must be evaluated and documented in the future
7. Consider pressure testing all tubing
8. Tubing scanning must be monitored by qualified personnel
9. Existing results will recommend increasing EndurAlloy from 6 joints to 10 joints while maintaining only bare tubing above EndurAlloy tubing

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