USING MICROSOFT EXCEL TO PLOT AND MONITOR DOWNWHOLE FAILURES

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ABSTRACT

The purpose of this paper is to provide an engineering tool to the Oil and Gas Industry that will assist in plotting and monitoring downhole failures by;

1. Type of failure (Tubing Leak, Rod Part or Pump Repair)
2. Depth of failure
3. Date of failure

Utilizing Microsoft Excel Software to build this engineering tool will provide to the user spreadsheet software that is utilized throughout the Oil and Gas Industry. This software is easily shared electronically and does not require excessive technical support.

Use of this engineering tool will provide you the opportunity to visually analyze the following;

1. Relationships between both similar and un-similar downhole failures
2. Determine increasing and / or decreasing failure frequencies
3. Determine if the failure mode is load or buckling related

Use of this engineering tool along with accurate failure data will assist you in visualizing downhole failures, reducing downhole failures and their associated operating expenses.

DISCUSSION

Why should you begin using this software to plot and monitor downhole failures? Many engineers can make engineering decisions utilizing only raw data. For you, maybe you do not need to incorporate this technique.

I have found that use of this technique of plotting failures by type, date and depth of failure; I am able to gain additional information and insight about the problem well. I am able to gain information and insight that I am not able to gain by just utilizing a page of raw data.

HOW DO WE START?

For those of you familiar with the Microsoft Excel Software, keep these suggestions in mind when plotting failures using the Excel Failure Graph:

1. Select an XY (Scatter) type of chart
2. Choose minimum depth as seating nipple depth plus footage to nearest 1,000 feet (i.e. -8,000)
3. Use 0 as your maximum depth
4. All failure depths must be input as a negative number (i.e. -8,000)
5. All failure dates become data points on your X axis
6. Format your y-axis so the x-axis crosses at the minimum depth (-8,000)

GRAPH NO. 1

Refer to Graph No. 1 as an example of a plot of downhole failures by type, depth and date of failure. By using your seating depth as the minimum depth and 0 as your maximum depth when setting up your Y-axis, all failures will be displayed relative to surface depth.

GRAPH NO. 2

Refer to Graph No. 2 as an example of the data page for Graph No. 1. Please note that the data page is set up by columns and all data entries are shown as a negative numbers except for the dates and the description of each failure. Listed below is a description of each column;

Column 1	Date of Failure	Date of failure, format this column so that all cells reflect a date style number
Column 2	Depth to Top of IPC	This depth assumes IPC tubing is installed continuously from this depth to the pump depth. If IPC is not continuously installed in this interval, consider adding a depth indicating the bottom of IPC.
Column 3	Pump Seating Nipple	This depth indicates the depth of the pump which can vary over the life of the well.
Column 4	Top of Sinkerbars	This depth indicates the top of the Sinkerbar section
Column 5	Depth to Tubing Failure	This depth indicates location of all type Tubing Failures
Column 6	Depth to Rod Failure	This depth indicates rod body, pin and box failures
Column 7	Depth to Pump Failure	This depth indicates location of pump repair or failure
Column 8	Description of Failure	Use this column to provide details on each failure

Additional columns of data can be added to better assist you in analyzing your particular well problem. Some examples of this additional information are shown as follows;

Depth to Top and Bottom Busted Joint;	To determine the impact of rod-on-tubing wear and / or erosion–corrosion wear indicated from hydrostatic testing of tubing
Depth of TAC;	To determine the impact of un-anchored tubing between tubing anchor catcher and seating nipple on rod failures and / or tubing leaks
Depth of Rod Guides;	To determine the impact of rod guides on rod failures and tubing leaks
Depth of Rod Body Failures;	To determine the impact of rod body failure on total rod failures
Depth of Rod Pin Failures;	To determine the impact of rod pin failures on total rod failures
Depth of Rod Box Failures;	To determine the impact of rod box failures on total rod failures

USING CHART WIZARD

If you prefer to create your graph by using the Microsoft Chart Wizard, then follow these steps after you have created your data page as listed above.

1. Create your data page in column style
2. Open data page and have it on your computer screen
3. Select Chart Wizard
4. Select XY (Scatter) as your chart type
5. Select Scatter (compares pairs of values) as your chart sub-type
6. Select next
7. Do not alter data range
8. Select series and create your series for your graph by selecting the add button
9. Type in the name of your series
10. Select your x values using the dates in Column 1
11. Select your y-values using the depths to failure (Columns 2-7 as shown above)
12. Select next
13. Select titles and input chart title, name for value (x) axis and name for value (y) axis
14. Select axis but do not change axis settings
15. Select Gridlines and leave a check only in major gridlines for value (x) axis and value (y) axis
16. Select Legend and locate it by checking right
17. Select data labels but do not change data labels
18. Select next
19. Select place chart as a new sheet
20. Select Finish
21. Your graph will appear on the screen.
22. Double left click the y-axis
23. Select scale

24. Input your seating nipple depth plus additional footage to reach the nearest 1,000 feet (i.e. -8000) as minimum
25. Input 0 as maximum
26. Input in value (x) axis crosses at, the same depth used in step 24 (i.e. -8000)
27. Select OK

Once you have created a failure graph for a well in your field, you can select and copy that graph for your next well. You will have to change titles and clear the contents of the copied data page and input data pertinent to your new well.

OBSERVATIONS UTILIZING EXCEL DOWNHOLE FAILURE GRAPHS

The following are a series of six (6) Excel Downhole Failure Graphs created from actual field data by following the above steps. For each graph there is a discussion of observations based on the type of downhole failure, depth of failure, date of failure and the relationship between each of these downhole failures.

OBSERVATIONS FROM GRAPH NO. 3

1. The pump depth has been lowered on two (2) occasions.
2. Sinkerbars has been installed since the first recorded data.
3. IPC tubing was installed after approximately 2 years.
4. After installing Sinkerbars, all tubing leaks were above the Sinkerbar section.
5. After installation of IPC tubing and an increase of Sinkerbars, the frequency of tubing leaks seemed to decrease, but the location of the tubing leaks seemed to be higher than previously experienced by this well.
6. After approximately three (3) years there was an increase of rod parts high in the rodstring.
7. During the last three (3) tubing leaks, the location of busted tubing seemed to remain at the same depth. The location of the tubing leaks were not always within the top and bottom busted joints.
8. The last tubing leak was located within a joint of IPC tubing

OBSERVATIONS FROM GRAPH NO. 4

1. The pump depth has been raised on one (1) occasion.
2. The footage of Sinkerbars has remained unchanged since installation.
3. There have been three (3) tubing leaks, all above the Sinkerbar Section. The location of the tubing leaks were not at the same depth. They were recorded at the same depth because no actual depths were recorded.
4. A full string of IPC tubing was installed after approximately fifteen (15) months.
5. No tubing leaks have been recorded since the increase of IPC tubing.
6. The last two (2) pump repairs occurred without other failures. These pump repairs were the cause of the well failure and were not considered as re-conditioned pumps.

OBSERVATIONS FROM GRAPH NO. 5

1. The pump depth has been lowered on two (2) occasions.
2. This well has operated for approximately 5.5 years without Sinkerbars or IPC tubing with several tubing leaks and rod parts.
3. Most of the rod parts have been rising in depth from 7,200 feet to 5,000 feet from surface.
4. Sinkerbars were installed and a tubing leak occurred later in the IPC tubing.

OBSERVATIONS FROM GRAPH NO. 6

1. During the first four (4) years of operation there were several tubing, rod and pump failures.
2. Most of the pump failures were actually reconditioned pumps.
3. The operational period from 1998 to 2002 more accurately reflected actual pump run life.
4. IPC tubing was installed before Sinkerbars and then removed.
5. Tubing leaks following installation of IPC tubing were higher and rising in the tubing string
6. IPC tubing was removed and Sinkerbars were installed with no further tubing leaks.
7. There were three (3) shallow rod parts following installation of Sinkerbars.

OBSERVATIONS FROM GRAPH NO. 7

1. The pump has been raised on one (1) occasion.
2. Prior to installation of IPC tubing, there were several rod and tubing failures near the pump
3. Since each of these rod and tubing failures had a pump repair, these repairs were probably not a failure but rather an opportunity to recondition the pump.
4. IPC tubing was installed and several tubing leaks occurred above the top joint of IPC tubing.

5. Sinkerbars were installed and the location of all but one (1) tubing leak lowered to above the top. Sinkerbar or into the Sinkerbar Section.
6. Sinkerbars were replaced with Polybars, the IPC tubing was replaced with bare tubing and no tubing leaks occurred for approximately two (2) years.
7. During the last three (3) years there have been two (2) tubing leaks above the Polybar section.

OBSERVATIONS FROM GRAPH NO. 8

1. This well has been operating for approximately 6.5 years with Sinkerbars in bare tubing.
2. This well has experienced no tubing leaks.
3. This well has experienced no rod parts.
4. This well has experienced no pump repairs.
5. Yes, this well has been producing throughout the last 6.5 years.

CONCLUSIONS

Plotting and monitoring downhole failures will assist you in reducing downhole failures and the operating costs associated with these downhole failures.

Plotting and monitoring downhole failures will offer you the following additional information;

1. Relationships between similar types of downhole failures.
2. Relationships between un-familiar types of downhole failures.
3. Changes in the rate of downhole failure frequency.
4. The impact of lowering pump depths on all downhole failures.
5. The difference between rod failures caused by load and downstroke buckling.

Using the Microsoft Excel software will allow you to customize your downhole failure graphs so you can monitor and visualize your specific well failure. You can accomplish this plotting and monitoring of downhole failures without excessive technical support.

ACKNOWLEDGMENTS

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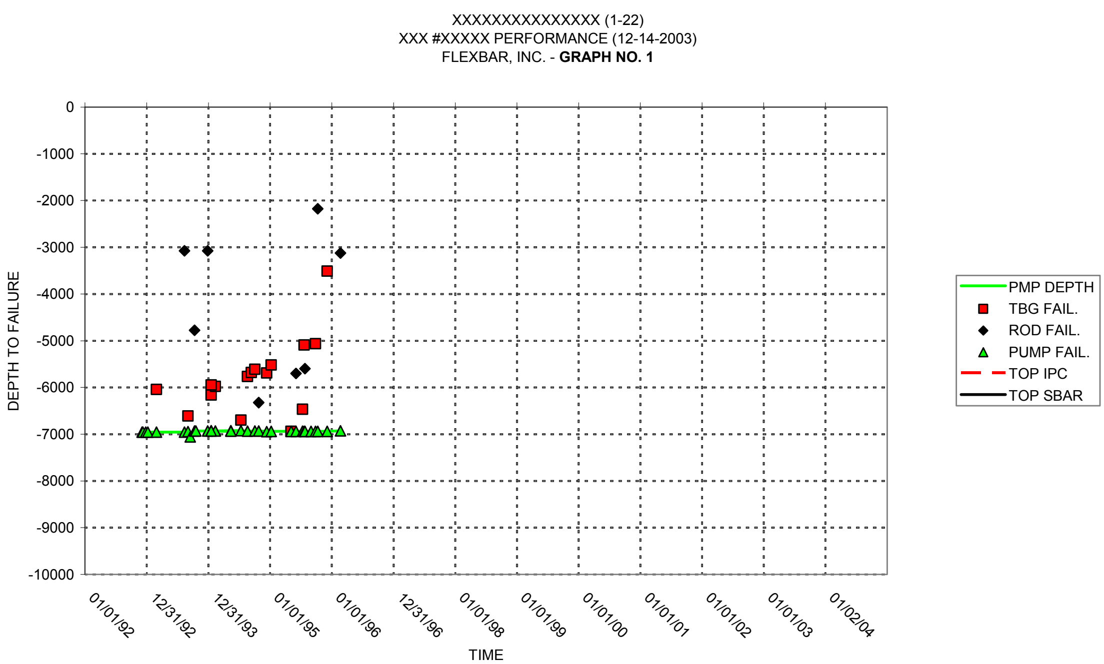

PERFORMANCE HISTORY(1-22)
XXXXXXXXXXXXXXXXXXXXXXXXX, WELL NO.
XXXXX

XXXXXXXXXXXXXXXX - XXXXXXXXXXXXXXXX **GRAPH NO. 2**

DATE OF FAIL.	DEPTH TO TOP IPC	PUMP S.N.	TOP OF BARS	DEPTH TO TBG. FAIL.	DEPTH TO ROD FAIL.	DEPTH TO PUMP FAIL.	DESCRIPTION OF FAILURE
08/17/92							
12/01/92		-6955					INITIAL POTENTIAL
12/04/92		-6955				**-6955**	PUMP REPAIR
12/08/92		-6955				**-6955**	PUMP REPAIR
12/26/92		-6955				**-6955**	PUMP REPAIR
01/07/93		-6955				**-6955**	PUMP REPAIR
02/27/93		-6955		**-6039**		-6955	TBG LK 29 JAP (916')
08/12/93		-6955			**-3075**	-6955	7/8" ROD PART
09/02/93		-6945		**-6610**		-6945	TBG LK 11 JAP (335')
09/15/93		-7056				**-7056**	PUMP CHANGE
10/11/93		-6931			**-4775**	-6931	7/8" ROD PART
10/18/93		-6931				**-6931**	LONG STROKE PUMP
12/27/93		-6931			**-3075**	**-6931**	STUCK PUMP
01/17/94		-6931		**-6162**		-6925	TBG LK 24 JAP (763')
02/10/94		-6931		**-5978**		-6931	TBG LK 30 JAP (953')
05/13/94		-6925				**-6925**	PUMP REPAIR
07/12/94		-6925		**-6699**		-6925	TBG LK 7 JAP (226')
08/20/94		-6937		**-5765**		-6937	TBG LK 37 JAP (1172')
09/12/94		-6945		**-5678**			TBG LK 40 JAP (1267')
10/03/94		-6933		**-5612**		-6933	TBG LK 42 JAP (1321')
10/26/94		-6933			**-6325**	-6933	ROD UNSCREWED
12/12/94		-6943		**-5688**		-6943	TBG LK 46 JAP (1453')
01/17/94		-6931		**-5948**		-6931	TBG LK 31 JAP (983')
05/13/94		-6937				**-6937**	PUMP CHANGE
01/07/95		-6939		**-5521**		-6939	TBG LK 45 JAP (1418')
05/05/95		-6939		**-6939**		-6939	BAD S.N.
06/03/95		-6939			**-5700**	-6939	7/8" BOX UNSCREWED
07/12/95		-6937		**-6466**		-6937	TBG LK 15 JAP (471')
07/22/95		-6939		**-5094**		-6939	TBG LK 59 JAP (1845')
07/26/95		-6939			**-5600**	-6939	7/8" BODY BREAK
08/31/95		-6939				**-6939**	PUMP CHANGE
09/27/95		-6939		**-5063**		-6939	TBG LK 60 JAP (1876')
10/10/95		-6939			**-2175**	-6939	1" F.GLASS BODY BREAK
12/05/95		-6939		**-3508**		-6939	TBG LK 109 JAP (3431')
02/21/96		-6929			**-3125**	-6929	7/8" BOX BREAK

XXXXXXXXXXXXXXXXXXXXXXXXXXXX (1-05)
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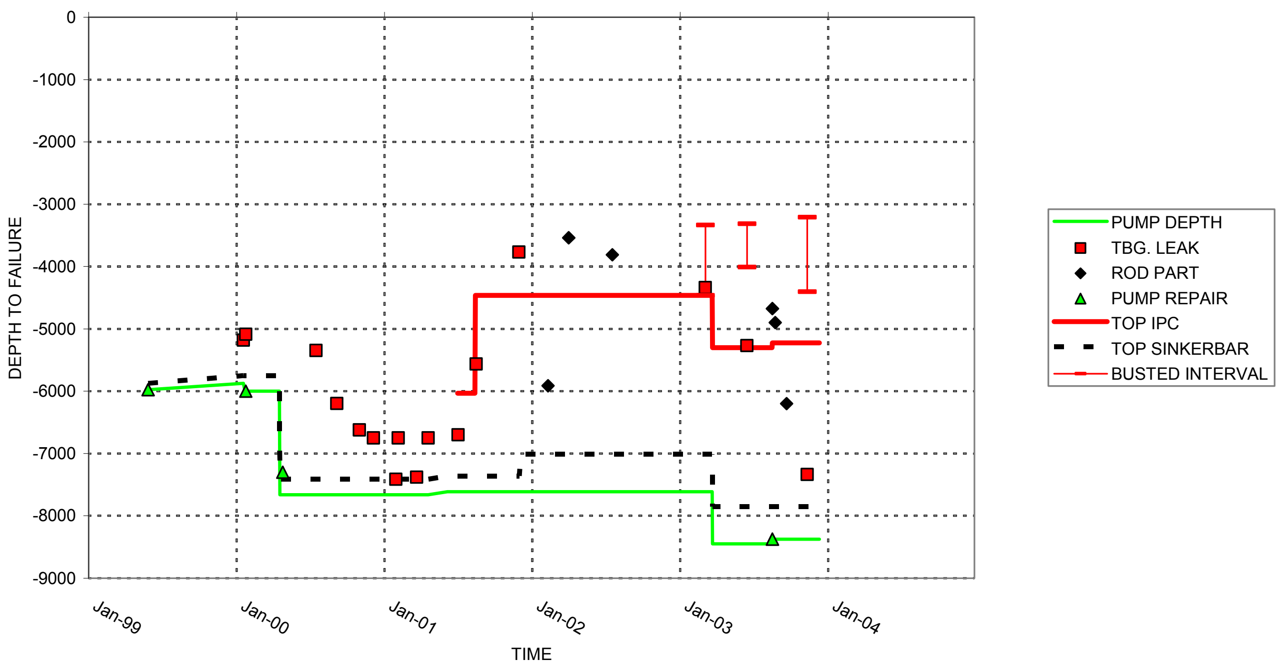
FLEXBAR, INC. - **GRAPH NO. 3**



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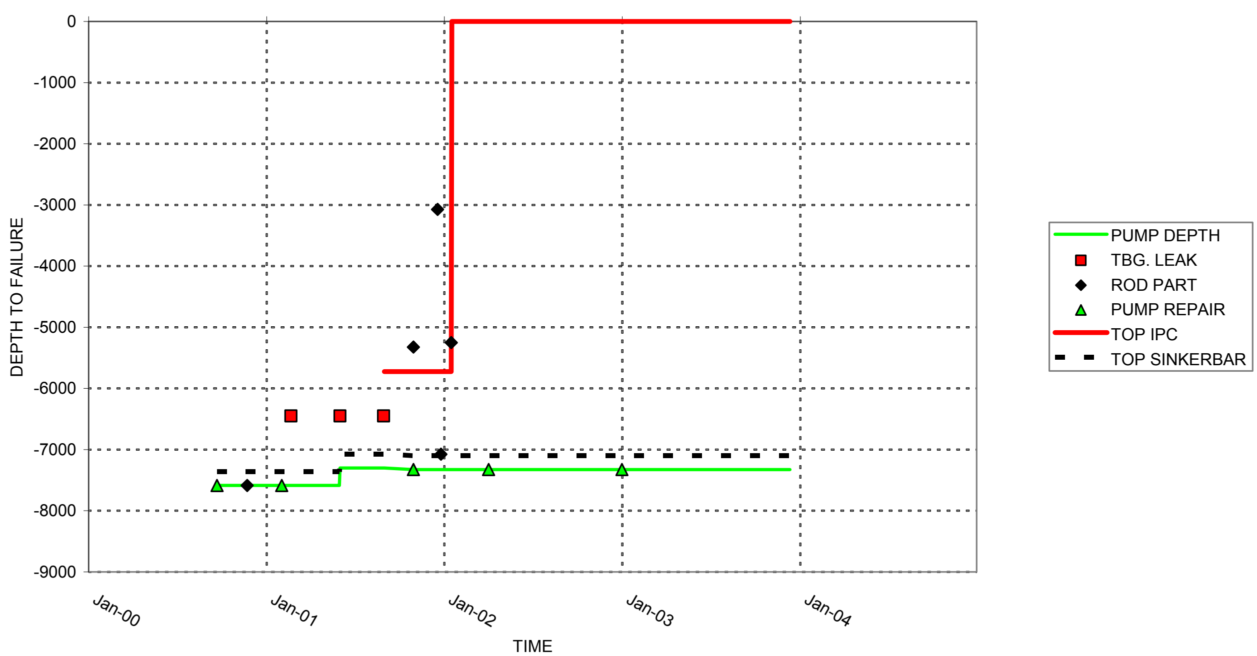

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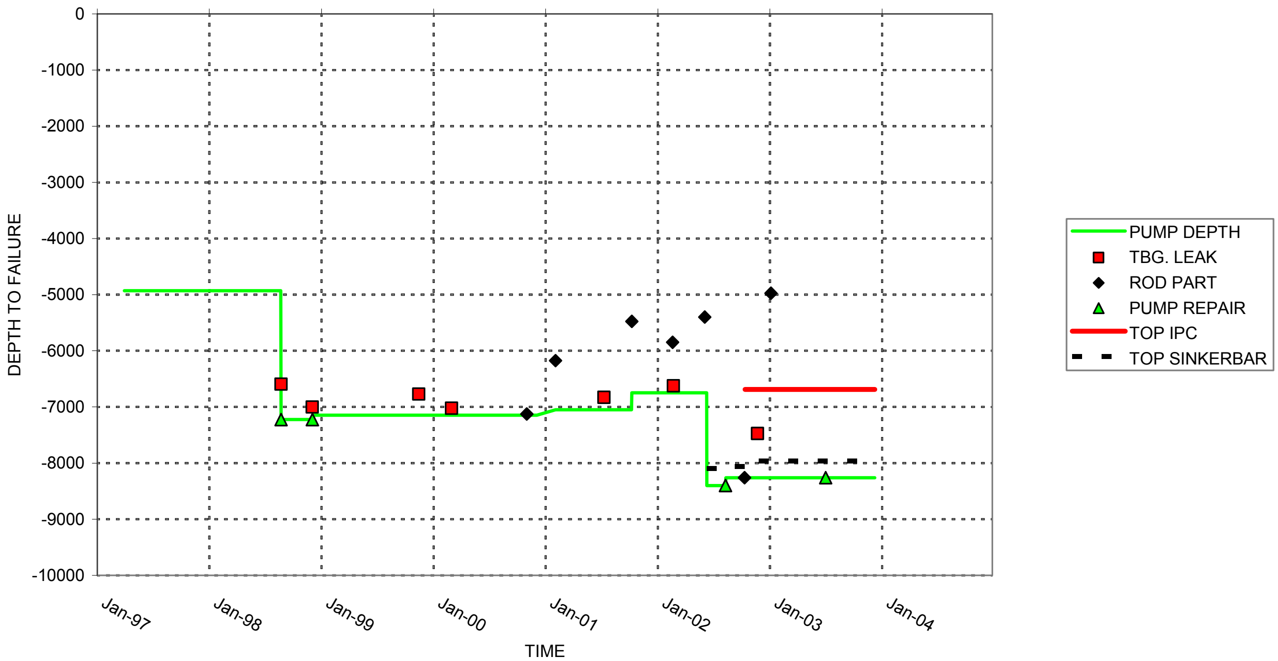

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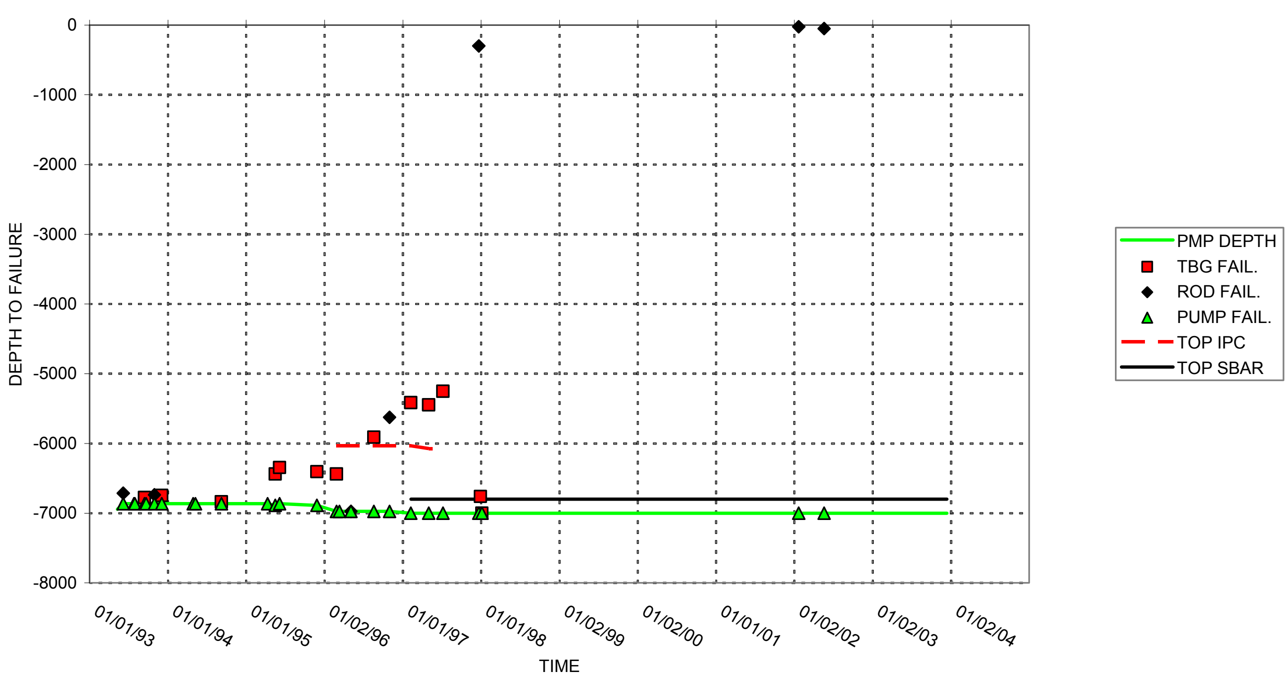

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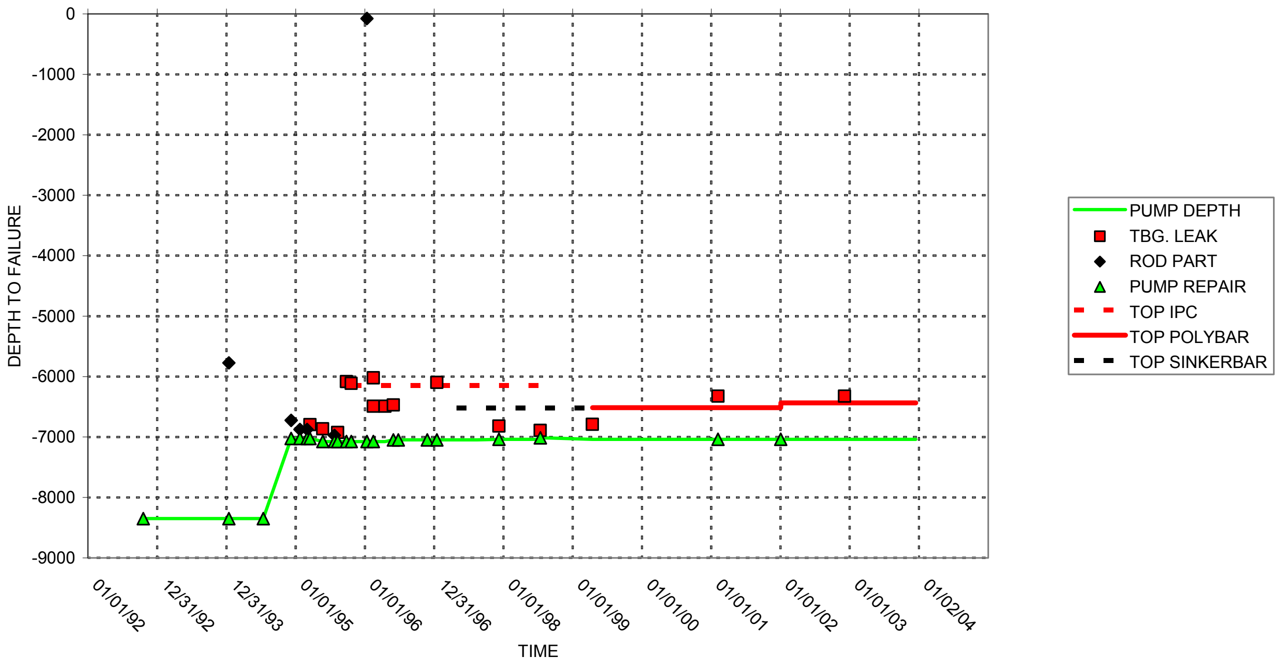

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FLEXBAR, INC. - **GRAPH NO. 8**